Editorial

THE Third Annual Report of the Australian Broadcasting Board, to which some reference was made last month, is naturally an important document to those who are interested in the progress of radio in Australia, for it summarises what has happened, and forecasts what will happen, over a period of about two years.

As mentioned last month, wholesale increases in the power of national stations are recorded, 12 of them going to 50 KW. 13 others will jump to the present maximum of 10 KW.

It is not intended to grant increased power to metropolitan commercial stations until experience has been gained from the high-powered nationals. The probability is that, in the commercial field, must be a matter of "all or none." The board was obviously not inclined to grant an increase in one case, but refuse it in another, where a channel might be wrecked thereby. It looks as though the city commercials will have to wait some time.

In addition to power increases, we note that there will be 20 new nationals, bringing the total stations in Australia to a very large figure, well over 150 all told. It is natural that the reader of the report should wonder just how these stations can be accommodated within the broadcast band and what proposals, if any, are suggested for easing the crush.

The addition of new channels for national stations and the increased power as a principle do not suggest that VHF broadcasting will find favor, if at all, for a long time. The report does mention the present FM experimental stations, and points out in general terms, the difficulties of transferring present stations to the VHF band.

Adding up all the points included or implied in the report, I can't see the national stations at least changing over, nor is there any hint at the moment that the commercials would be required to do so. It is not reasonable to visualise the expenditure of money in making expensive power increases, only to abandon them in a short time for VHF stations.

One point which will require watching, I think, is the possible allocation of television frequencies. The report does not encourage any hope for change in the television outlook but it does refer to the difficulty overseas manufacturers have in making television sets to tune over bands which range from about 40mc to several hundred mc. This can be done only by expensive and difficult tuning systems, including wave change or turret tuning.

It is to be hoped that, when television does appear out here, we won't make it too hard for set manufacturers. It should be possible to select one of the bands adequate in size to accommodate all our likely services. Fortunately, when we do have television, such problems will already have been experienced overseas and the answers more clearly indicated.

Apparently, Gore Hill is still to be the location of our first experimental television station. The report reveals plans for a 500ft mast, 820 feet above sea level. A high-gain aerial at the top should deliver quite a signal.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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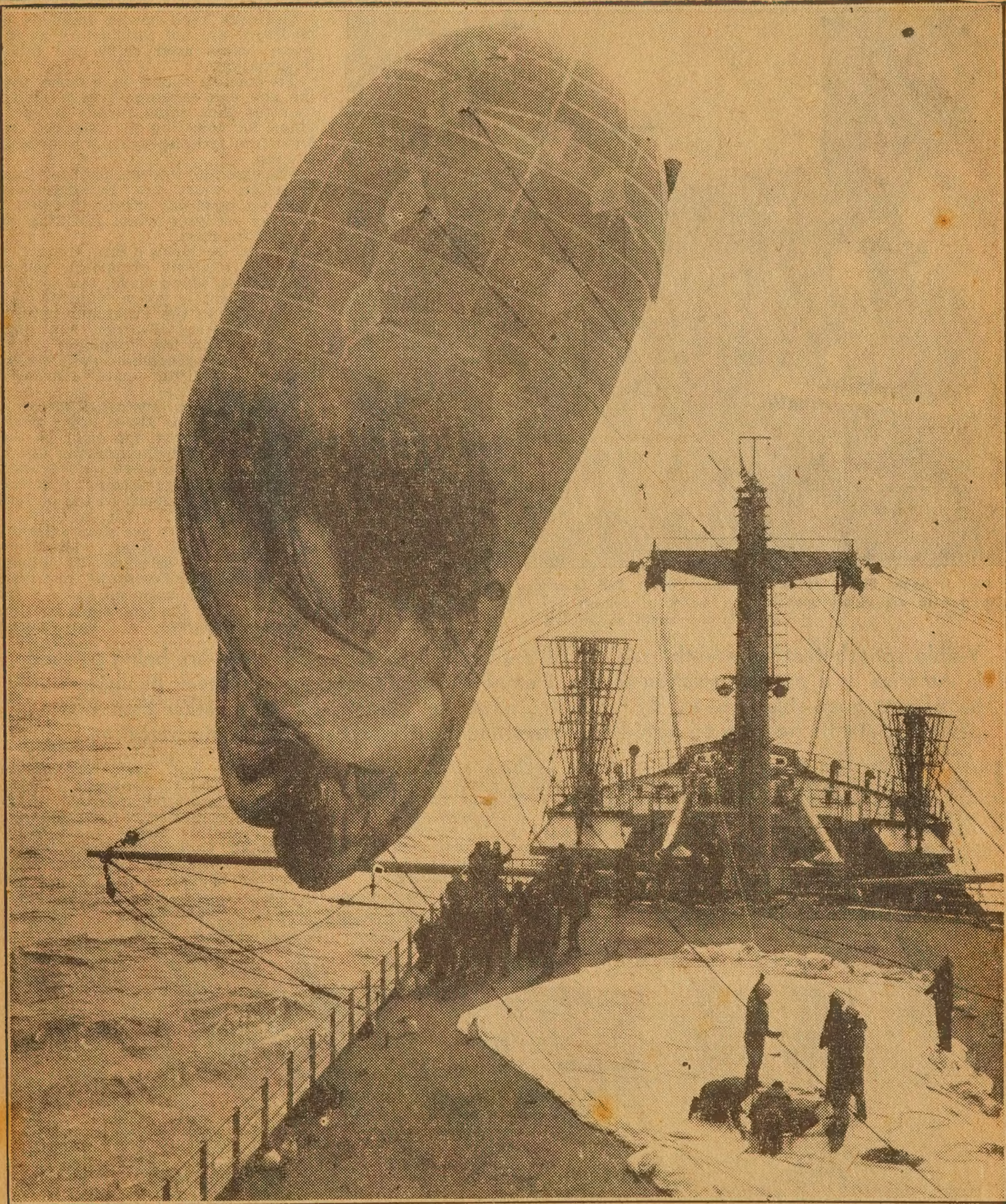
OUR COVER PICTURE

Mary Munro III, a craft operated by the British Ministry of supply, searches the sea and air up to 6 miles off the Cumberland coast for harmful waste from atom piles. A crewman collects dust samples with a vacuum cleaner.

SHIP CARRIES VOICE OF AMERICA



The Voice of America (VOA), United States Government international radio broadcasting network, has outfitted a former cargo vessel as a powerful radio station. Specialised radio equipment will enable the vessel, which will be known as the Courier, to relay VOA programs from varying broadcast locations with greater effectiveness, particularly in reaching peoples behind the Iron Curtain. The Courier will be manned by a United States Coast Guard crew. Voice of America personnel will operate the radio facilities. The ship, which was commissioned recently, has sailed on a scheduled two-months "shakedown" cruise. On board the Courier, a crew readies the antenna-balloon for release. The balloon will be held by the winch-operated line through the hatch opening seen in the centre of the white canvas.

VISIBLE SPEECH PATTERNS MAY

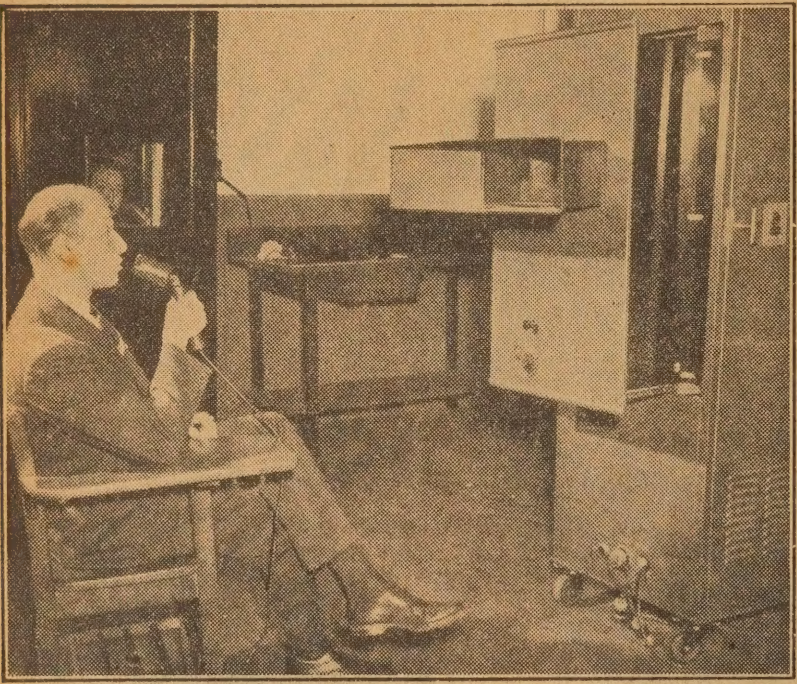


Fig. 1. Edgar Bloom, research chemist on the Bell Telephone staff, was the first person to use visible speech as a means of conversation. He is talking to the girl seen in the booth on his left.

Visible speech techniques—the subject of much research during the war—are being pursued in America as a possible solution to the dilemna of people who cannot speak because they have never been able to hear. By presenting everyday speech as a visual rather than a sound pattern, patients may be educated to understand it without other aids to interpretation.

THE title may sound rather paradoxical but the idea of enabling totally deaf persons to converse by visual aids was one of the objectives of Alexander Graham Bell's early researches.

Many technical difficulties have hindered the progress of recording the visible patterns of sound, but recently certain war-time researches of the Bell Telephone Laboratories of New York have been disclosed and they have perfected and produced apparatus for carrying into effect the visual portrayal of sound phenomena by electrical means.

Ordinary oscillograph methods of portrayal are not satisfactory as the wave traces seen carry too much information.

To portray sound in a form that the eye can encompass in a glance requires that some means be provided for selecting the essential information and displaying it in orderly fashion.

The essential information for visual reception must not be dissimilar from the essential information which the ear analyses when fulfilling its normal function.

The ear performs a time frequency intensity analysis of speech taking the complex sound waves and spreading them out in space patterns corresponding to the overtones present in the waves. Further, the high frequency and low frequency overtones are segregated, and strong overtones register more markedly than weaker ones.

Visible speech portrayal attempts to conform to the above noted analysis undertaken by the ear. In the Bell Telephone technique the visual pattern presents the overtones spread out vertically, high frequency at the top and low frequency at the bottom of the pattern.

Strong overtones are shown darker than the weaker ones. The time relationship is satisfied by linear spacing along the horizontal direction; and the visible patterns move from right to left as the words are spoken.

A spectrogram of the words "speech we may see" appears in Figure 2. The spectrogram is made upon a sound spectrograph which essentially comprises a magnetic tape sound recording means which plays the sound back repeatedly into a scanning filter, the pass band of which is moved slowly across the

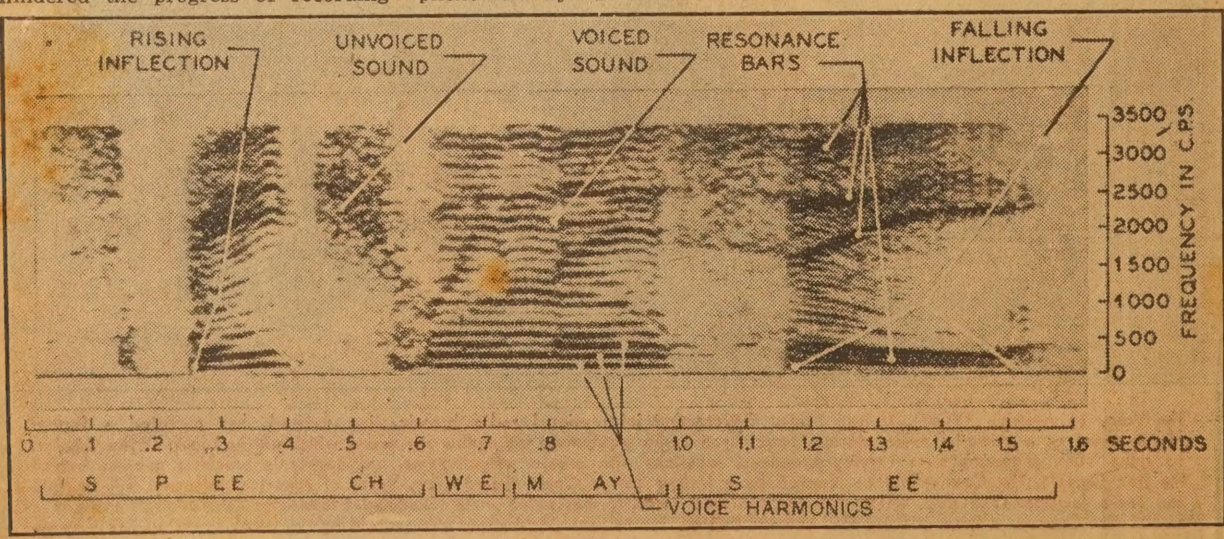
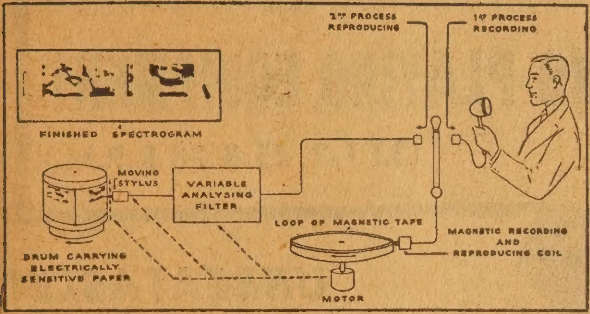


Fig. 2. A sound spectrogram of the words "Speech we may see" spoken in a normal voice. It is hoped that, with practice, the eye will be able to register and interpret visual patterns with much the same facility as the ear interprets sound patterns.

ALLOW TOTALLY DEAF TO "HEAR"



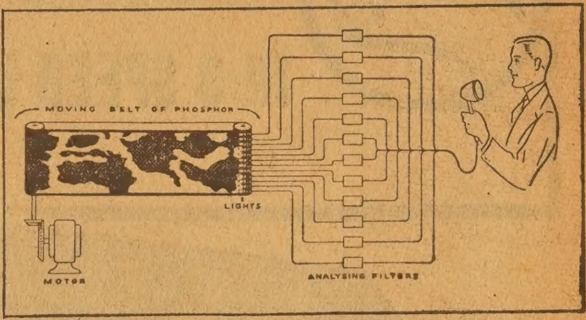


Fig. 3. The simple mechanical spectograph shown on left will produce a permanent inked record of short phrases. The phrases are recorded on tape, then played through several times while the stylus traces the energy concentration in different frequency bands. The more recent electronic "Translator" performs a similar function instantaneously by producing a glowing pattern on a moving, phosphor-coated belt.

frequency spectrum. The scanning filter output operates a stylus which makes a trace upon electronically sensitised paper. (Fig. 3).

If words are spoken by different people having voices of varying characteristics the words have a similar basic appearance in the visual pattern. This is well illustrated in the comparative pictures of Figure 4, where different voices have each uttered the same words "unusual speeches." The spectrogram diagrams give a visual representation of the varying accents of the recorded words.

LATER DEVELOPMENT

A later development of the sound spectrograph is also shown in Figure 3; it is called a visible speech translator since it converts speech intended for aural reception into a form suitable for visual perception.

The speech of the operator is received into a microphone and the impulses are conducted to a set of twelve adjacent filters which divide the speech band (about 100-3600 cycles) into 12 groups of approximately 300 cycles wide.

The output of energy from the individual filters excites twelve minute lamps which in turn excite a phosphor coating on the moving belt thereby producing visual patterns which move from right to left.

The filters are so arranged and so connected with the lamps that the lowest lamp is excited by the lowest frequency, and the uppermost lamp by the highest frequency.

Primarily the portrayal of sound offers a great service to the deaf and the severely deafened. It offers a service to such unfortunate people in two ways; it enables them to read instantaneously (after appropriate training) the conversation of others; and it enbles them to control the production of their own speech.

This latter use is of great assistance in training children who are deaf at birth, and who consequently cannot learn to speak by an imitation of their elders. Making sounds without ears to hear is just as difficult as drawing without eyes to see the results.

Other applications come readily to mind such as detailed studies of the characteristics of sounds emitted from musical instruments, from animals, birds and even noisy and disturbing machinery. Some patterns prepresentative of such sounds are shown in Figure 4.

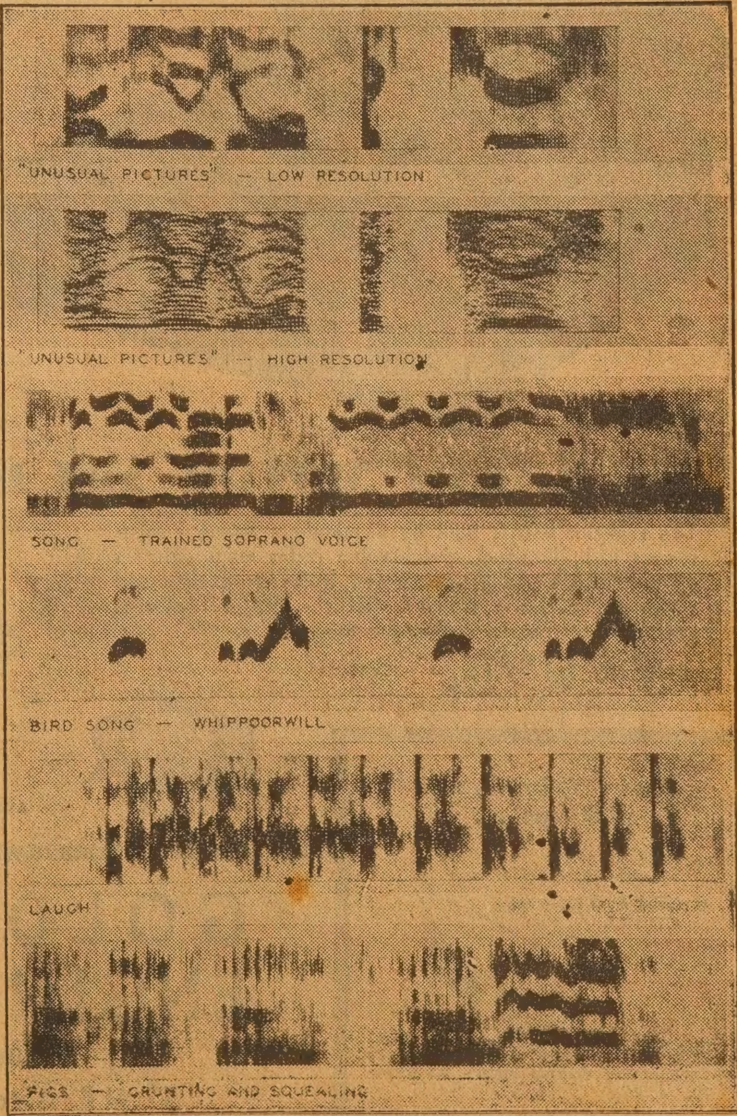


Fig. 4. Some typical spectrograms. Note the similarity between the traces for the words "unusual pictures", though spoken by quite different voices. The traces of a soprano singing and an ordinary laugh are immediately evident in their content.

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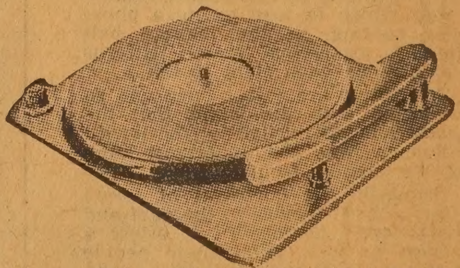

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FULL TECHNICAL INFORMATION GLADLY MADE AVAILABLE.

ATOM POWER IDEAL FOR AIRCRAFT

Propulsion of aircraft is an ideal use, in many respects, for nuclear energy and efforts to fly with this power will be successful, according to Dr. Miles C. Leverett, a scientist at the Aircraft Nuclear Propulsion Project, Oak Ridge, Tennessee. He made the statement before a meeting of the Institute of Aeronautical Sciences in Chicago.

HERE, to a greater extent than in any other application, the advantages of a highly concentrated source of heat can be used efficiently. It is only such high-performance premium uses of energy which can today justify the consumption of as rare a resource as uranium-235 or plutonium-239.

Development of this power source has great military significance.

Thus, a nuclear aircraft could circle the earth many times without stopping, flying around the world at local midnight, with the lower vulnerability which night flying confers. Careful husbanding of fuel, programming of flight speed and altitude, and closely timed flight plans would become unnecessary.

It could fly at maximum speed, at any altitude, and be sure of having enough fuel to return to home base. It would be limited only by the freedom of the aircraft and power plant from breakdown, and by the ability of the crew to endure long hours of flight and exposure to nuclear radiation. Many hitherto impossible missions would be possible.

ENERGY AVAILABLE

One pound of uranium-235, on undergoing fishion, will liberate heat equivalent to the energy of 1,700-,000lb of gasoline. Superiority of nuclear fuel over chemical fuel is thus 1.7-million to 1.

Many proposals for an atomic power plant have been made, including the use of turbine-driven propellers, a turbojet in which the reactor takes the place of combustion chambers, and a ramjet engine, also substituting a reactor for a combustion chamber.

In all cases, except that of the ramjet and other direct air cycles, it is necessary that heat be transported in a coolant from a reactor to the propulsion machinery.

The design of the reactor will be influenced greatly by the coolant chosen. The reactor may be thought of as a more or less cylindrical body throughout which a fissionable material such as uranium-235 or plutonium-239 is distributed.

The reactor also contains passages for the flow of the coolant through it—necessary for the removal of heat—and usually contains a material called a moderator, such as graphite, ordinary water, heavy water, beryllium, or beryllium oxide.

The reaction starts with the capture of a neutron by a nucleus of, say, uranium-235. Since neutrons are present in small concentrations in the atmosphere everywhere, this serves to start the reaction.

Immediately after the capture of the neutron, the U-235 nucleus disintegrates, with the liberation of two to three neutrons and two atomic nuclei (fission fragments), both smaller than the original nucleus.

Most of the energy of fission is carried off by the fission fragments; this energy is imported to the material into which they are cast, and appears as heat. Gamma rays and beta rays are also given off in the fission process.

The two or three neutrons given off are ejected into the body of the reactor, and may meet one of three different fates: (1) They may escape entirely and be captured outside by some parasitic nucleus in the structure of the shield or its surroundings; (2) they may be captured by some of the nonfissionable materials in the reactor itself; (3) they may be captured in another U-235 nucleus, following which additional neutrons will be given off.

REACTION CONTINUES

If one can design the reactor so that as many as 40 pc of the neutrons given off in the fission are captured in other fissionable nuclei in such a way as to cause fission there, the reaction will continue indefinitely until the fissionable nuclei are used up.

The basic problem of reactor design is to reduce to acceptable low value the first two methods of loss of neutrons.

A substantial part of the energy of a reactor appears as kinetic energy of the neutrons, and as ionising radiation such as gamma and beta rays.

The neutrons and gamma rays, if allowed to escape with complete freedom from the reactor, would make it necessary for humans to stay more than a mile from an operating reactor.

Moreover, since the fission products themselves are radioactive and continue to emit gamma rays even after the chain reaction has stopped, one could not approach closer than a mile even after it had been shut down. Hence, a shield would have to be provided.

WEIGHT PROBLEM

The shield would be the heaviest object aboard the aircraft, possibly 50 to 100 tons in weight, with provisions for removing heat. Hence, a large aircraft would be needed even though no chemical fuel were carried. Fortunately, the shield and reactor replace a fuel load which is often 75 tons in large aircraft.

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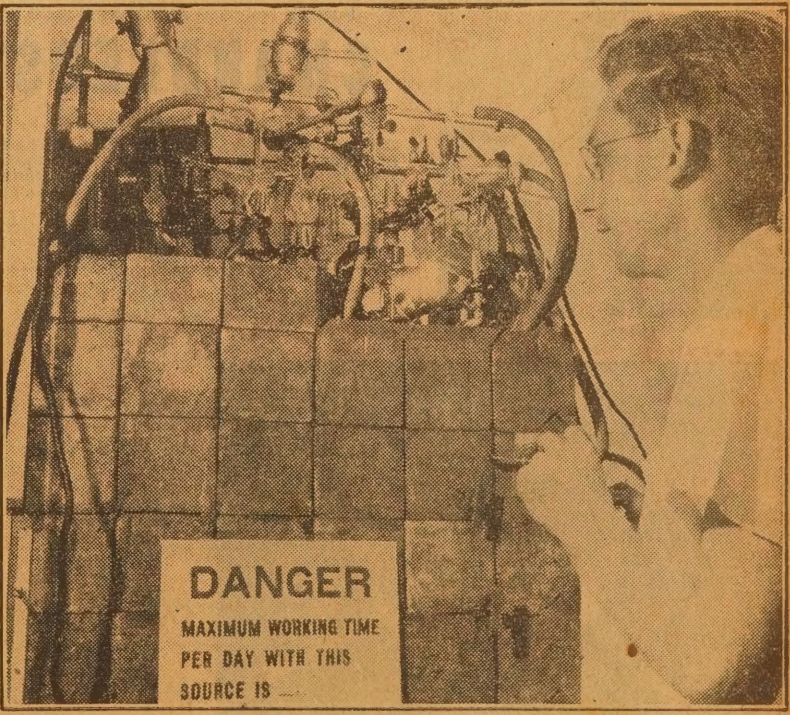
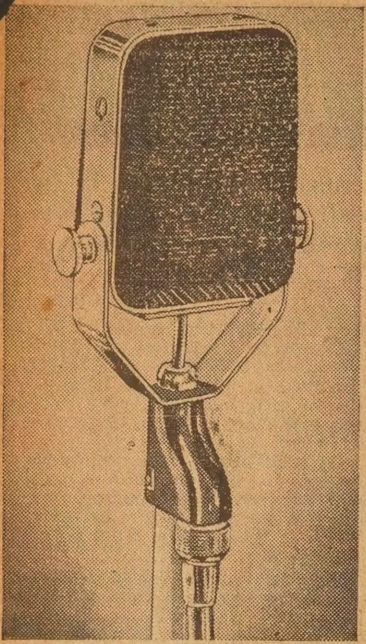


Strictest precautions have to be taken to protect all personnel working in proximity to radio-active materials. Standard measures involving walls of lead bricks, remote control mechanisms and limited periods of exposure, present serious problems when related to aircraft and crew requirements.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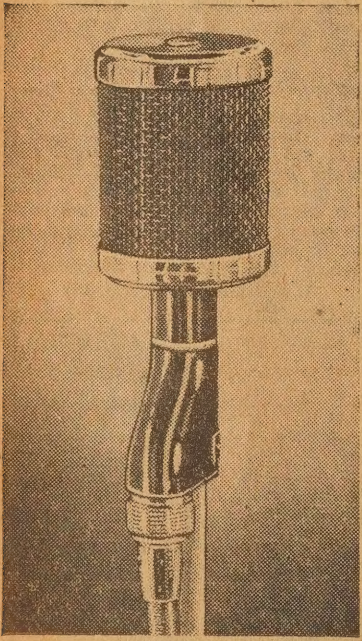
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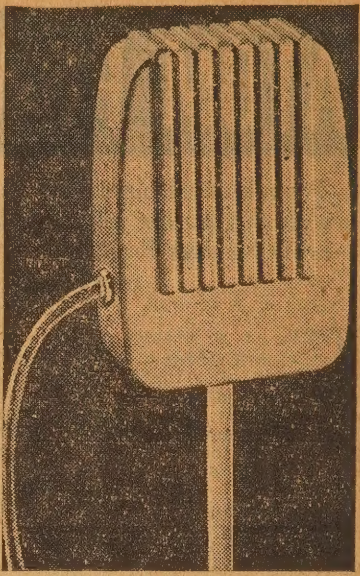
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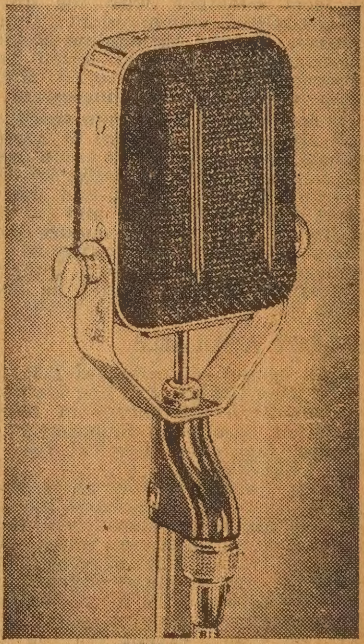
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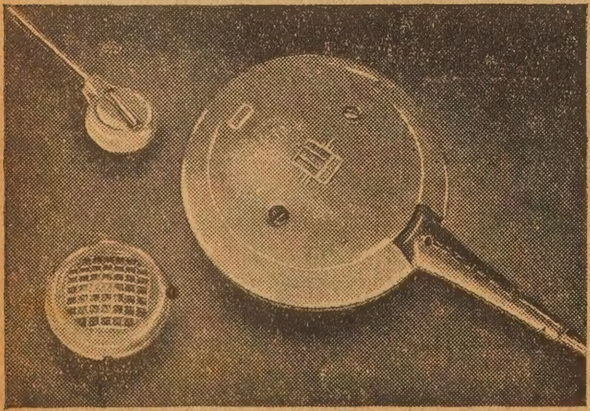
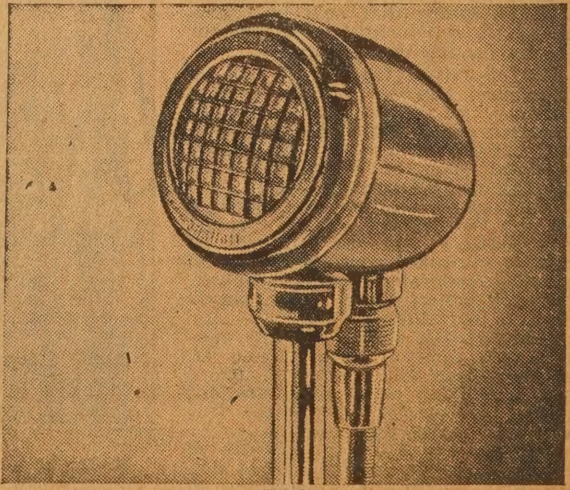

(K407 top left) (BDX bottom left) PS50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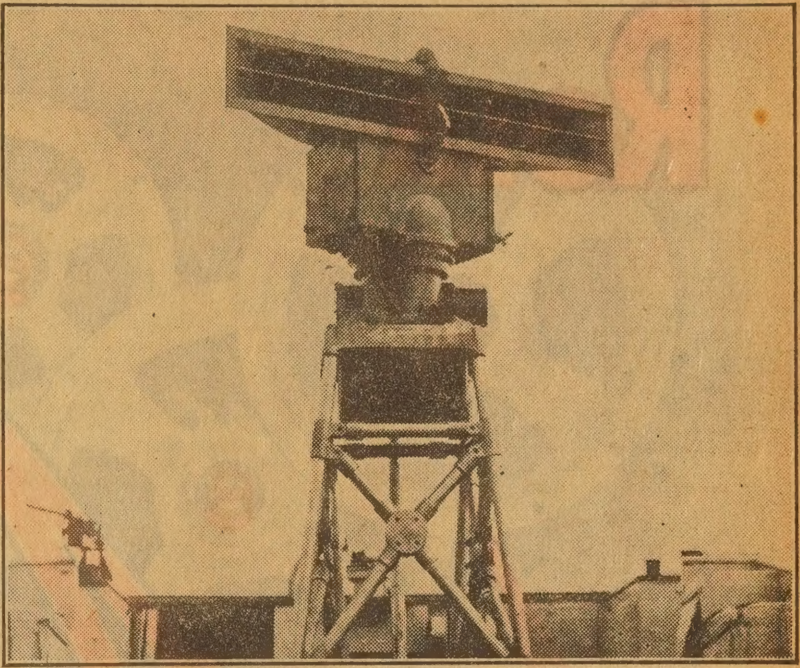
B.E.A. SETTLES FOR DECCA RADAR



Decca short-range radar equipment is already in extensive use for marine purposes on harbours and rivers. Ranges as short as 20 yards are possible with this class of equipment.

British European Airways have now announced that all their aeroplanes are now going to be equipped with the new Decca short range navigational aid. This simple statement, in itself, marks one of the most important yet made, for the Decca Navigator pinpoints an aircraft's position to a matter of a few yards (metres) over most of its range.

by Charles Gardner from London

THE Decca system offers a very precise method of air navigation most suited for traffic control in congested areas, so that collisions in the air should become almost impossible, and it gives full "area" coverage rather than relying on airlanes.

A further big point in its favor is that Decca coverage already exists over the greater part of Europe and is immediately available for use. All that has to be done is to fit the aircraft installation which weighs only 120lb (54 kgs) and is also relatively cheap.

The BEA announcement probably marks the end of discussions, negotiations (and even quarrels), which have gone on ceaselessly since the end of the war. The key question of which short range navigational aid should be used over Europe has now been argued back and forth for six years.

Some people have wanted one thing; others have wanted another, but somehow no conclusion was ever reached. This was not because there were no suitable aids available. There were, in fact, several, of which Gee, VOR and Decca were but three. Gee, incidentally, is the British war-time bomber aid, which depends on radar, and VOR is the American omni-range, which depends on radio-beacons toward and away from which the pilot can fly.

To many people it seemed a tragedy that aircraft could still be lost in Europe's winter weather; could still fly into mountain tops when off-course, and could still be delayed by antiquated control systems, when several solutions to the problem were at hand and available. The situation was analogous to a protracted argument as to which of several fire brigades to call out, the fire itself being allowed to burn merrily on.

POSITIVE STEP

BEA has now, therefore, taken a positive step to break the impasse, and at the same time to give a lead to other European countries by her example. Many of those countries are already known to approve of Decca in principle. The timing of the announcement was noteworthy, because, in session in Paris, was the Regional Air Navigation Conference of the International Civil Aviation Organisation (ICAO), an inter-governmental body, charged with the duty of recommending standard navigational aids for Europe.

The British decision, therefore, put unambiguously before that conference the viewpoint of BEA, the biggest operator outside the United States. It is hoped that this will give a lead to a number of countries who are known to support Decca, and who will realise that BEA would not have made such an emphatic choice without the fullest of trials in all weathers.

The attitude of the British Ministry of Civil Aviation is known to coincide with that of BEA, and, just before Christmas, Ministry spokesmen were quite clear in their evaluation of Decca as the most promising aid available both for navigation and for precise air traffic control. Furthermore it has coverage at all altitudes, which is vital for the new jet-liners, and it is almost infinitely elastic in provding flight-paths from anywhere to anywhere.

The actual working of the Decca gadget, is from the pilot's viewpoint, as simple as possible. It draws, on a map above the pilot's dashboard, the track the aeroplane is making over the ground. It does this quite automatically, as the pen follows every move the machine makes. Thus, at a glance, the pilot can see exactly where he is, and he can also steer the pen straight to his destination, and can tell, almost to a second, the time he will arrive.

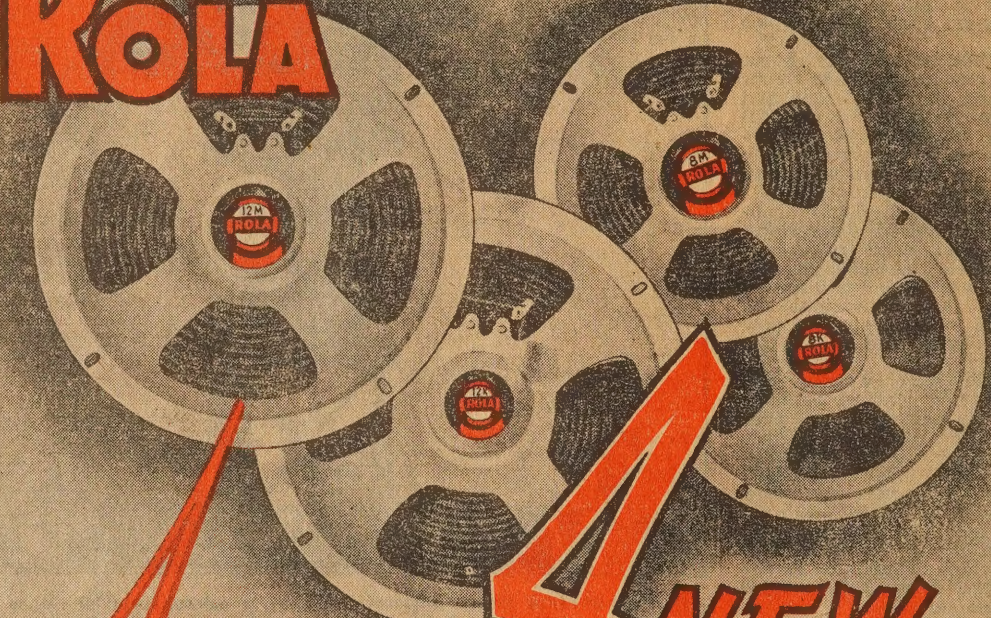
Basically the Flight Log (as the map is called) is an extension of the widely used Decca Navigational System for shipping. This works from a criss-cross of radio lines laid down by a "chain" of four transmitters on the ground. The pointers on these dials each give the navigator a single position line, but a "cut" of two or more such lines gives an absolute fix.

DECISION FOR EUROPE

The accuracy of the system is very high, ranging from practically no error in the centre of each "chain" to a maximum of five miles (8 km) on the circumference. Reliability, too, is high, and, in the last year, the total time that Decca was off the air, in its existing chains, was 90 seconds, the longest single period being for four seconds.

(Continued on Page 11)

ROLA



Announces 4 NEW "FLUXMASTER" MODELS

Now readily available from all Rola distributors, these new Fluxmaster models, equipped with Rola's new centre-block magnet system, are the most efficient of their type ever to be developed. Because of their wide range and excellent transient response, they are ideally suited for use with standard receivers and amplifiers.

SPECIFICATIONS

Model	Power Handling Capacity (Watts)	Fundamental Diaphragm Resonance (C.P.S.)	Frequency Range (C.P.S.)	Voice-Coil Impedance (Ohms at 400 C.P.S.)	Air Gap Flux Density (Gausses)	Diameter of Baffle Opening (Inches)	Transformer Type	Price*
8K	5½	85 – 95	90 – 6,000	2	7,780	7	C	64/4
8M	7	85 – 95	90 – 6,000	2	9,450	7	C	76/9
12K	5½	80 – 90	85 – 5,500	2	7,780	11	C	81/5
12M	7	80 – 90	85 – 5,500	2	9,450	11	C	92/7

*With Transformer. Includes 33⅓% Sales Tax.

DEFIES RADIO-ACTIVE PARTICLES

Deadly radio-active materials hidden behind a thick concrete wall, can now be safely studied and photographed under a microscope by atomic scientists using a new instrument jointly developed by the American Optical Company's Instrument Division, at Buffalo, N.Y., who built the device, and the General Electric Company.

FIRST of its kind, the instrument is being installed in the Knolls Atomic Power Laboratory, operated by General Electric for the Atomic Energy Commission.

According to Dr. Kenneth H. Kingdon, technical manager of the laboratory's technical department, the instrument is expected to make possible investigations that have never before been accomplished on the effects of radiation damage to materials.

The instrument is a special microscope for examining the structure of metals, combined with camera, periscopes and an illuminating system, in such an arrangement that light can get in and out through the thick walls of the test chamber, but dangerous radiations from the radioactive specimens are completely blocked.

REMOTE CONTROL

Operated by remote control, the instrument permits atomic researchers to work in complete safety. Some sort of remotely controlled "mechanical hands," similar to those developed by KAPL engineers and first announced in 1948, could be used to place the specimens in position, and to remove them after examination.

Original schematic designs and specifications for the microscope were developed by Col. H. H. Zornig, of the KAPL staff. Scientists and engineers of the American Optical Co., under the direction of Joseph D. Reardon, put the instrument into practical form.

Light for illumination of the specimen comes from an arc lamp outside the thick-walled test chamber, and goes into the chamber through a lens system placed in a tubular hole through the wall. The light is reflected from the specimen, and comes out again through another series of lenses, to form the magnified image.

MIRROR SYSTEM

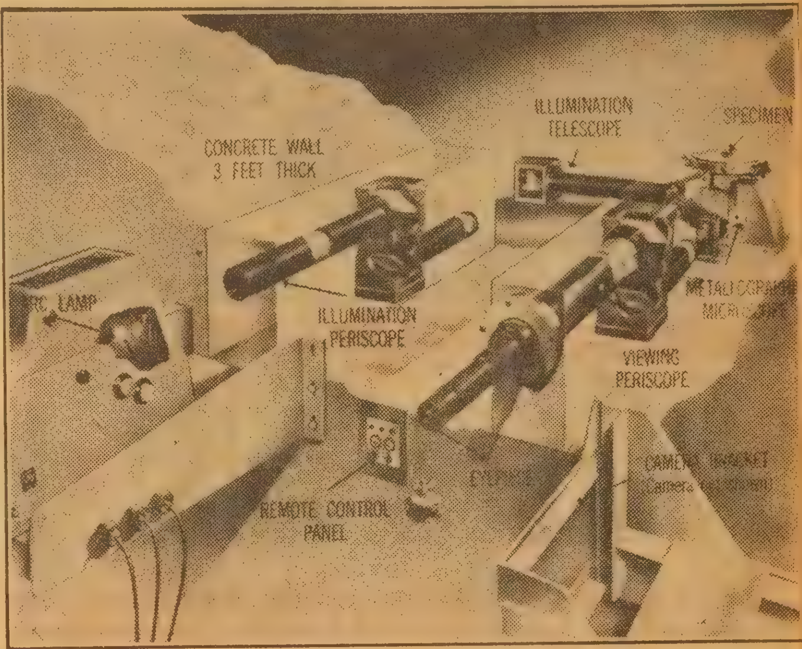
Both lens systems are offset by means of mirrors, which change the light path from horizontal to vertical, and then back to horizontal again. Radioactive radiations from inside the test cell are not reflected and cannot get around the offset. If the tube were straight, however, they might be able to emerge through the opening for the lenses.

In using the microscope, which extends into the test chamber, the specimen is put into place on the microscope stage. Looking through a single eyepiece, the operator employs the remote controls to get the specimen adjusted and properly focused. Then the visual eyepiece is exchanged for a photographic one, and the camera is swung into position to make the photograph.

At the lowest power, the instrument shows the specimen in its actual size, without any magnification, whereas 1000 diameters magnification may be obtained with the highest power. These different powers are achieved by the use of several objective lenses for the microscope, which are mounted on a revolving turret and can be swung into place, again by remote control, as desired. The objectives are so adjusted that it is not necessary to refocus when changing from one power to another.

Polarised light, consisting of vibrations in a single plane, as opposed to ordinary light in which the vibrations are in many different directions, is invaluable in the study of metals, and may also be used. This is made possible by a light-polarising slide in the path of light from the illuminator. By remote control the slide may be put in or out of position as desired.

The new microscope has been delivered by the American Optical Co. to the Knolls Atomic Power Laboratory, and will shortly be in operation.



A series of lenses and offset mirrors transmits light in and out of the shielded chamber but traps radio-active particles. Remote control allows accurate manipulation of the specimen and the focusing arrangements.

B.E.A. SETTLES FOR DECCA RADAR

(Continued from Page 9)

It is for all these factors, plus the fact that Decca already exists over a wide area, and is paid for, that the British Ministry of Civil Aviation wants to see BEA's lead followed all over Europe.

Another point of the Flight Log is not only that it tells the pilot exactly where he is, but that it provides an almost unlimited number of controlled traffic lanes in congested areas.

With the advent of jets and the increase in air traffic, the present systems of control, based on single radio beams and "holding" beacons, are likely to break down inside three years. By then it will not be possible to channel all the liners down a few main sky-roads, each plane separated from the next by 1000 feet (300 metres) of height or by 10 minutes in time.

Those main roads will get so congested that the added complication of jets climbing and descending on them will be almost unhandleable. Something will have to be done, and BEA has now made it clear that, in its view, this "something" should be the Decca system with the Flight Log.

Heaps of rusting metal like this one on Manus Island cost the Allies millions of pounds. Calculations suggest that rust and deterioration reclaims metal as quickly as we refine it.

SCIENCE V. RUST, CORROSION

It has been estimated that the amount of valuable material lost annually through rust and corrosion about equals the annual production of metal throughout the world. This represents a very large sum and in the face of the dwindling sources of raw materials it is little wonder that scientists and industrialists are at last awakening to the fact that something must be done in the way of rust and corrosion prevention.

by Calvin Walters

IT was during the war that the nations learned the sharp lesson that we cannot go on for much longer ignoring the fact that the supply of valuable minerals is not inexhaustible. There are ample supplies for many years to come of the important minerals such as iron, copper, &c., but the world will soon be short of others.

In the past the lower grade ores were not considered worthy of treatment, but the time is coming when consideration must be given to this aspect of metallurgy. The treatment of these ores, however, will result in higher-priced metals.

Thus, the development of a satisfactory method of rust prevention has become an urgent necessity.

One of the greatest causes of rust and corrosion is exposure to water, which, of course, includes the weather and moist air.

SMALL BEGINNINGS

Rust can be likened to a cancer in the human body. It may commence as a minute, almost invisible, spot, spreading with insidious character until it has eaten its way into the very heart of the metal, thus destroying it for all practical purposes.

With the exception of gold, platinum, silver, and the other "noble metals," all metals are subject to corrosion to some extent.

With some metals such as aluminium the corrosion acts beneficially by protecting the metal surface beneath the corrosion.

Aluminium is so sensitive to the action of the air that it always has a coating of aluminium oxide on its surface. The formation of this coating cannot be prevented and is the reason why aluminium cannot be soldered by ordinary means. The surface can be polished on a buffing wheel, but even as the wheel leaves the surface the oxide coating has again formed.

It is in iron and steel that most of our rust troubles are centred, because these metals are the most troublesome in this respect.

In the past and at the present time the most common practice for rust prevention is the application of protective coatings such as paint or electroplating.

These processes are effective for only a relatively short period of time and only then while the coating remains intact. Once the coating becomes broken by even the slightest microscopic hole, corrosion will commence and continue.

The process of galvanising used in roofing iron, wire netting and water pipe manufacture is well known. This is a process of coating iron with zinc and is one of the most effective of the coating processes, but its effectiveness is governed by the perfection of the coating. Like all coating methods, it only requires a minute hole or a small flake of the coating to fall off the surface and rust will start to undermine the rest of the metal.

It is impossible to use painting and plating methods in all cases. For instance the surfaces of the water jacket in the castings of internal combustion engines cannot be treated in this way. Neither can the inside of boiler tubes be effectively treated in this way. The same can be said of the water channels in the cores of car radiators.

Modern research has brought forth new theories concerning the causes of rust.

It appears that one of the basic causes is an electrolytic action brought about by electrolytic differences between metal and water.

In all metals there may be slight differences in composition between adjacent parts. There may also be small differences caused by unequal results of previous treatment between adjacent parts.

When such metal is immersed in water the minute differences may be sufficient to set up very small differences of potential between them.

A single bar or sheet of metal may be affected in this manner, and even were the metal uniform in composition and treatment, a slight deformity brought about by bending, or a tap with a hammer may so affect the metal as to set up this potential difference between the deformed part and its neighbor.

ELECTRIC BATTERY

In effect a small battery is formed in which the two plates are actually parts of the same metal surface and the water is the electrolyte.

These minute forces which are set up in this battery are effective over long periods, running into years. The net result is a working of great havoc in the metal over a period of time.

This electrolytic action is greatly accentuated when two metals of a dissimilar nature are brought together. Copper and iron are examples.

Another important cause of corrosion is a similar electrolytic action caused by small differences of concentration of substances dissolved in the water.

Oxygen is a good example of this action. This gas is barely soluble in water but is so highly concentrated at the surface that a piece of metal partly submerged becomes severly rusted at the water surface.

Whilst the effect is highly pronounced with regard to oxygen, the same thing results with metal totally submerged where it is in contact with water which has a non uniform concentration of dissolved substances.

CHEMICAL ADDITIVES

During the war when shortages of materials for plating and painting forced research into other channels for the discovery of effective rust prevention methods attention was directed to the use of chemicals which, added to water, reduced its corroding effect on immersed metals. These chemical methods were already known to some extent and many chemicals were used as inhibitors. They consisted mostly of the tannins, amino compounds and certain phenols.

Attention was directed to the more effective chemicals with the result that effective rust prevention was carried out by the addition of silicates, chromates and phosphates to water in which metals were to be immmersed.

Any of these compounds, when added to water in very small concentration exerts a tremendously powerful effect on the metal.

It is a fortunate circumstance that these agents act readily on the metals such as iron and steel which are subject to severe corrosion.

It seems that these substances act by forming insoluble coatings of compounds produced by the action of the chemical on minute traces of the metal which has dissolved in the water.

Take for instance a piece of iron immersed in a solution of sodium chromate. The amount of chromate need only be 25 parts to 250 million parts of water.

The immersed iron is quickly covered by a thin film of iron chromate. This film is continuous over the surface of the iron and when scratched immediately heals itself. It is also an insulative film and protects the metal by preventing the flow of electric current necessary for corrosive action.

THE METAL ITSELF

In addition to the use of inhibitors, research is directed toward improving the metals themselves to make them resistant to corrosion.

Along these lines, of course, the stainless steels show the greatest resistance to corrosion. These are essentially steel with the addition of chromium and are expensive to produce and difficult to work.

It has been discovered that copper is the most effective metal which can be used as an alloy with steel in order to increase the rust resistant properties.

There appears to be a limit to the quantity of copper used and ordinary steel is greatly improved by the addition of only .05 pc of copper.

Any further increase in copper content must be accompanied by the addition of nickel.

Corrosion does not only take place in the presence of water. There is another type of corrosion, which is responsible for a great amount of wastage in industry. This is the corrosion brought about by contact with salt air, fumes of acids and alkalis and the scaling caused by the application of heat.

For protection against this type of corrosion the application of metal coatings by spraying is proving of great advantage.

The process makes use of a hot flame of acetylene gas into which is fed a wire of the desired metal. The molten metal is directed by a strong blast of compressed air onto the article which is to be sprayed.

To illustrate the value of this, consider processes which require the transfer of heat. In some tubes, for example, copper is the most effective metal because of its great capacity for heat conduction.

In other cases, these tubes have to remove the heat from exhaust gases at temperatures to 2000 degrees Fahrenheit. This temperature is too high for copper which would rapidly fall to pieces.

FUSING PROCESS

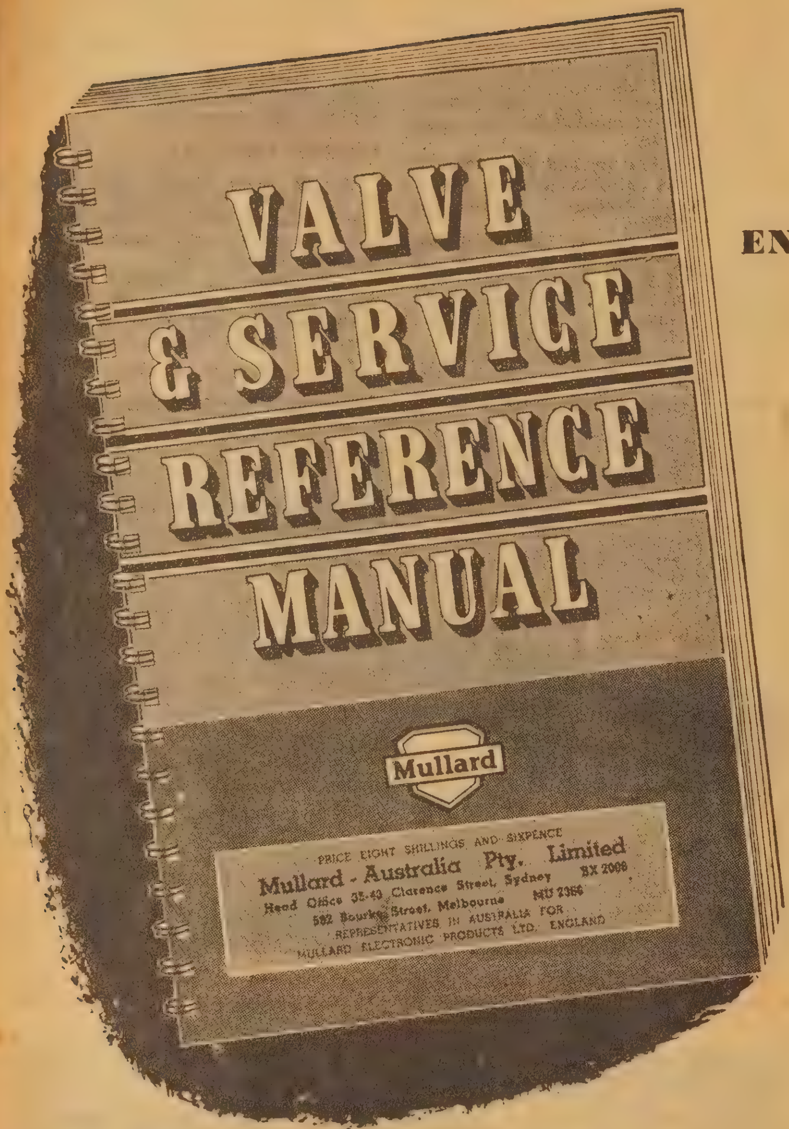
It has been found that an alloy of aluminium and copper will withstand this amount of heat but copper and aluminium cannot be fused together as an alloy.

Aluminium is sprayed onto the tube surface and the lot heated in a furnace for one hour at 1600 degrees. The result is a tube with an

(Continued on Page 92)

In the City! The gleaming array of enamel, chromium and stainless steel in milady's kitchen isn't just for show. A surface finish is essential to prevent the whole lot rusting away.

In the country! Where would the countryman be without his galvanised tank? The coating of zinc protects the steel underneath and then protects itself with a coating of zinc oxide.



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MR5-52

Technical Review

NEW ULTRASONIC ALARM SYSTEM DETECTS INTRUDERS

Motion of an intruder within a confined space may be detected by the ultrasonic burglar alarm system developed by the Alertronic Protective Corporation of New York. The system does away with customary protective forms such as foil dowel screens, electric linings, and open wiring. Its medium is a pattern of ultrasonic waves.

THE equipment operates on the Doppler principle. It consists of an ultrasonic oscillator, transmitting and receiving transducers and a receiver tuned to the frequency of the transmitted wave. For each transmitter there is one receiver. The transmitter and receiver are contained within the master control unit shown in the photograph. The transducers are connected to the control unit by shielded cables.

The space to be protected is filled with sound energy of a frequency slightly above the audible range. This energy is radiated constantly in all directions and the frequency of the received energy is constant. Some of the energy is received directly from the transmitter and some is received in the form of multiple reflections from surfaces within the space.

STANDING-WAVE PATTERN

As long as there is no movement within the enclosure, a stable standing-wave pattern is established and the received frequency remains constant. However, when movement of any object occurs, the frequency of energy reflected from the object increases or decreases as the object approaches or recedes.

This difference in pitch is picked up by the receiver, amplified and used to set off the alarm.

The equipment also detects the presence of a flame. Because of the low density of the hot air composing a flame, ultrasonic energy is reflected exactly as with a solid object. The flickering flame and the hot cone of air above it, behave like a moving intruder, and set off the alarm.

In general, the size of the flame that the instrument will detect depends upon its sensitivity setting. For any given sensitivity, it will detect a flame about one-quarter the size of the minimum detectable intruder.

Figure 1 is a schematic diagram of the ultrasonic transmitter and receiver. The transmitter consists of a Hartley oscillator driving a magnetostriction transducer.

PICK-UP UNIT

The pick-up transducer also operates on the magnetostriction principle.

All units are equipped with tamper switches, so that if an attempt is made to disable the system the alarm relay will be released.

A small motor-driven vane built into each transmitter unit when actuated causes operation of the system for test purposes.

In general, a single system of this type can protect a volume of up to 20,000 cubic feet; the exact capacity depending on the contents of the enclosure.

If greater coverage of a single enclosure is desired, the use of several units is recommended rather than just one.

It is claimed by the manufacturer that the extent of coverage provided far surpasses that given by existing systems.

Several central station operating companies have been using this equipment during the past year. Other users include the Atomic Energy Commission, the Canadian Government and the Department of Defence.

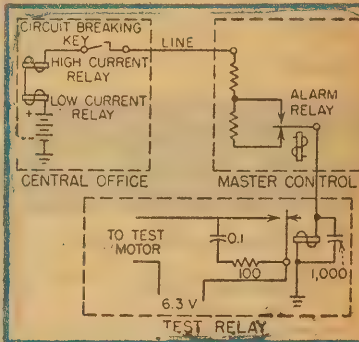


Fig. 2.—Test of overall alarm system performances can be initiated at will by central station operator with circuitry shown.

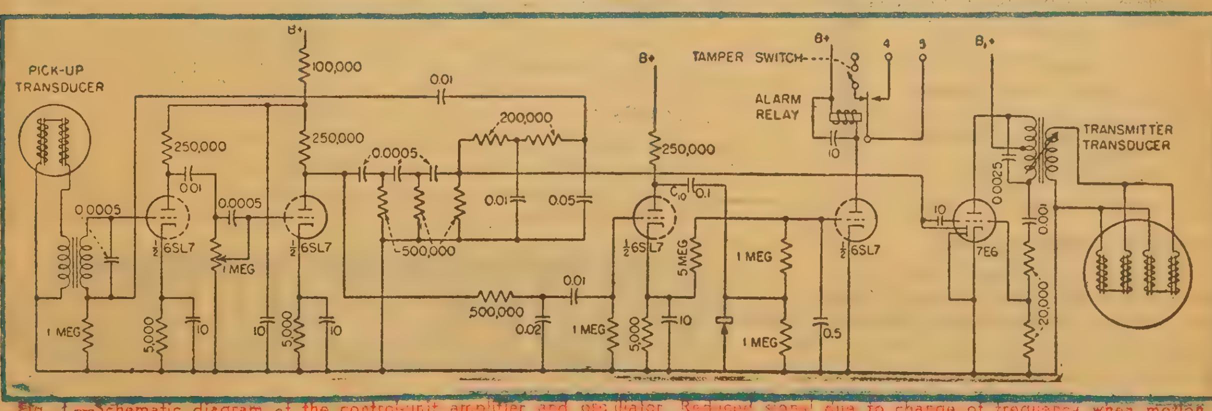


Fig. 1.—Schematic diagram of the control-unit amplifier and oscillator. Reduced signal due to change of frequency when motion is present in protected area releases alarm relay.

"BOUNDARY DISPLACEMENT" MAGNETIC RECORDINGS

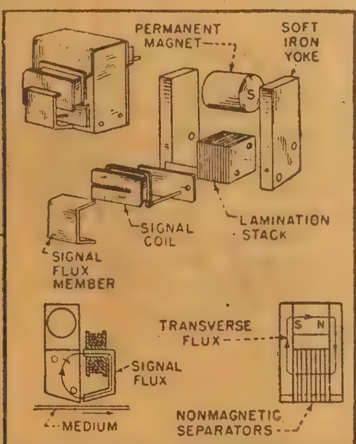
A new system of tape recording, described by H. L. Daniels in "Electronics" is comparable in method to the familiar variable-area film system. It holds considerable promise for audio work.

THE system was originally derived to record transient phenomenon on high-speed magnetised drums, involving frequencies of around 100,000 cps. It can be readily applied, however, to conventional magnetic tape.

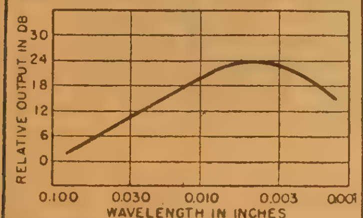
The usual tape recording system employs a high frequency bias, which leaves the tape inert in the absence of audio signals. When audio is present, the tape retains a pattern of varying degrees of magnetisation, the result being comparable with variable density film recording.

The new method employs a head, which is so constructed that, in the absence of audio signal, the two edges are magnetically saturated in opposite polarity, with a narrow non-magnetised strip in the centre.

When audio currents are passed through the head, they vary the tape area, which is positively and negatively saturated. When scanned by a normal playback head, the relative degrees of magnetisation produce a resultant induced volt-



Structure of the new recording head.

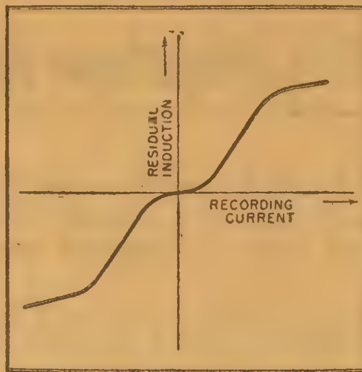


A typical response curve for a boundary-displacement contact recording.

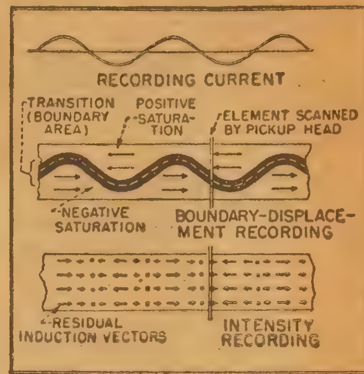
age across the playback coil.

Obvious advantage of the system is that it completely ignores the remanence curve of the tape and obviates the need for critical bias adjustments. Given optimum head design, full advantage can be taken of the ability of a tape to store information.

Experiments indicate that the distortion level of the system and the effect of contact eccentricities are



A typical playback remanence curve for conventional tape recording.



Comparison of the new technique with conventional intensity recording.

less important than with the variable density method.

The frequency response of the system is naturally limited by the speed-wavelength function in the upper register.

The record can be made readily visible by running the tape through a bath of carbonyl iron powder in alcohol. The powder can either be removed subsequently or "fixed" with a suitable binder without greatly affecting the replay characteristic of the tape.

ANOTHER NOVEL SPEAKER HORN

This drawing gives the essential dimensions of a novel loudspeaker horn described by W. B. Denny in "Audio Engineering." Scaled for a 12" speaker, the unit is constructed on a wooder frame and covered entirely with quarter-inch ply. Large surfaces are backed with absorbent board and an extra thickness of ply to prevent vibration. The shelves support and stiffen the curved surface and give the enclosure from the front the appearance of a trinket cabinet. The writer preferred horn as a "Woofer" using separately mounted speakers for the middle and high register. Top corner of the room acts as mouth of horn.

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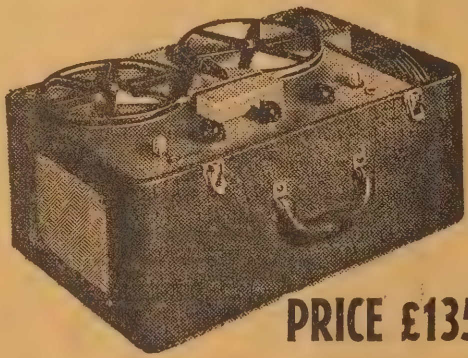

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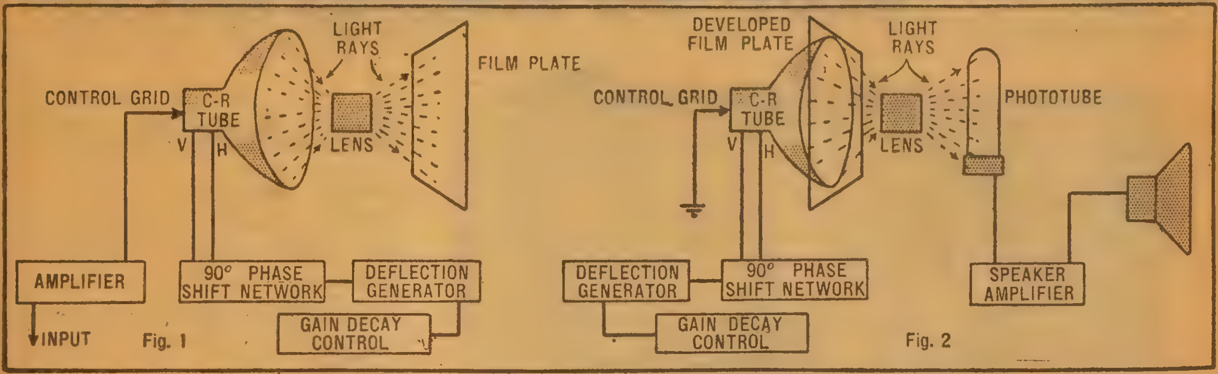

Figure 1 (left) illustrates diagrammatically the recording process, while the playback set-up is shown on the right, (figure 2). The inventor claims that spot control circuits are less prone to "wow" effects than mechanical drive systems. Extreme stability is claimed to be possible.

A new sound recording system, devised by J. P. Shields and featured in "Radio & Electronics" avoids the necessity for moving parts of any description. Using techniques borrowed from film and disc recording, 30-minute programs can be stored on a square of ordinary photographic film.

AS the bias on the cathode-ray tube is varied, the intensity of the spot of light will vary in accordance with the audio signal applied to the input of the amplifier.

This so far stationary spot of light is deflected by the following means: The deflection generator produces a 40 cpm sine-wave output which is applied to the 90-degree phase-shift network. This splits the output from the deflection generator into two parts which are equal in frequency and amplitude, but differ in phase by 90 degrees.

Fig. 1 is a block diagram of the recording system. It operates as follows: The cathode-ray tube generates a beam of electrons which produces a movable spot of light on its screen. This movable spot of light is focused by the lens onto the unexposed film plate.

The output of the amplifier is connected to the control grid of the cathode-ray tube so that its bias will vary in accordance with the audio frequency variations applied to the amplifier's input.

APPLIED TO PLATES

The two outputs from the phase-shift network are applied to the vertical and horizontal deflection plates of the cathode-ray tube. The above-mentioned spot of light will now form a circular trace, or more exactly the spot of light will rotate at a speed of 40 rpm.

By varying the gain of the deflection generator linearly from maximum to minimum, the rotating spot of light will travel in a spiral toward the centre of the cathode-ray tube screen.

Thus it can be seen that the developed film plate will consist of a spiral trace with very close spacing between adjacent turns on the spiral. Each line of the spiral will consist of varying light and dark areas which correspond to the audio-frequency variations applied to the input of the amplifier.

A little more than 30 minutes of recorded material can be placed on a single 12-inch disc.

In the development of this new sound-recording system several rather large problems had to be solved. For example, a suitable oscillator had to be chosen for the deflection generator.

The conventional L-C oscillator naturally would be of no use here, as the values of inductance and capacitance required for operation at 40 cpm would be much too large to be practical.

FINAL CIRCUIT

Several types of R-C oscillators were tried and the circuit that was finally chosen was the phase-shift oscillator. This type of circuit requires only one tube; it is extremely stable; relatively small values of resistance and capacitance are required for its operation at 40 cpm; and when properly adjusted it is capable of almost pure sine-wave output.

The type of 90-degree phase-shift network used requires a balanced input, so a modified cathodyne phase inverter is used for this purpose.

The outputs from the 90-degree phase-shift network are fed to two push-pull deflection amplifiers whose outputs are connected to their respective sets of deflection plates. Modified R-C amplifiers are used throughout this system, as they were found to be as satisfactory in this case as direct-coupled amplifiers.

An rf voltage-doubling power supply is used with the cathode-ray tube to provide maximum brightness and sharpness of focus. The type of cathode-ray used in both the recording and reproducing systems is a type 10HP4.

The type P4 phosphor is satisfactory, as its decay characteristics are sufficiently rapid to allow its use at the commonly-employed audio frequencies. A small amount of high-frequency equalisation was used to produce output flat from 20 to 20,000 cycles from the photocell.

The recording process has to be reversed for reproduction.

In Fig. 2 is shown a cathode-ray tube identical to the one in the recording system. A beam of electrons is generated within the cathode-ray tube, producing a spot of light which is focused by the lens onto the photocell.

The deflection generator and 90-degree phase-shift network are identical to those used in the recording system.

The control grid of the reproducing cathode-ray tube is grounded and thus maintained at a fixed potential to keep the spot of light on the cathode-ray tube at a fixed intensity.

As in the case of the recording system, a spiral trace will be produced on the reproducing cathode-ray tube. It will be identical to the trace on the recording tube, as the same type of deflection generator and 90-degree phase-shift network is used in each case.

The film plate, on which audio-frequency sounds were recorded, is now developed and placed between the face of the cathode-ray tube and the lens so that the spiral trace recorded on the developed film will correspond to the spiral trace on the reproducing cathode-ray tube.

As the spot of light—maintained at a constant intensity—travels spirally toward the centre of the screen of the cathode-ray tube at the same speed as the recording spot of light, it will pass through the varying light and dark areas of the film and strike the photocell.

SCANS RECORDING

The light of varying intensity striking the photocell causes corresponding voltage variations from the photocell. These voltage variations will be an exact facsimile of the audio-frequency variations applied to the recording system amplifier's input.

The output from the photocell is then amplified and applied to a suitable loudspeaker.

It is apparent that many advantages are to be gained by use of the Shields recording and reproducing system.

What is most important the system does not require motors or mechanical-drive systems, and so far as is known (a thorough patent search was made before applying for patents), it is the first recording and reproducing system which is entirely electronic in operation.

NEWS AND VIEWS OF THE MONTH

A-bomb damage

HOW dangerous is an atom bomb? We know that the actual blast and heat in the immediate vicinity is immense, and is capable of almost disentigrating its target. But what of the danger from radiation effects after the blast? At first it was thought that the area would be so radio-active that no one could exist there for months afterwards.

While the actual site of the explosion may remain in a dangerous state for some time, latest experiments indicate that the after effects of radiation are not so deadly as believed. At a recent test in Los Vegas, Nevada, infantrymen were able to attack their target only minutes after the blast.

The troops were accommodated in trenches 7000 yards from the explosion, and were able to come within 1000 yards immediately afterwards without danger.

This despite the fact that the 300ft steel tower at the scene of the explosion had completely vanished.

Tests of this character are vital in estimating the possible use of the atom-bomb in warfare, and, for that matter, other atomic weapons which are in the course of development. It is a great handicap in the use of any weapon should it render the attacked area unsafe for occupation troops. Such a state of affairs may well rebound on the users, and through tactical considerations bring casualties on themselves.

There is still the problem of deactivating the central area of the explosion which will often remain dangerous for some time. Altogether it would seem that the after effects of an atomic weapon may yet impose upon it one of the severest limitations.

★ ★ ★

Jets or turbo-props?

AMERICANS believe that the experience gained by British aircraft engineers will solve the problem of whether jet or turbo-prop engines will be most satisfactory for long range air-liners.

The turbo-prop engine uses a gas-turbine to drive airscrews, as against the straight jet and its reactive drive. Many consider it has many advantages in providing the flexibility of the air-screw and greater economy in the use of fuel. It cannot as yet compete with the jet driven aircraft in sheer speed.

British experience with jet airliners has emphasised a number of operational problems, the importance of which could not be correctly assessed without actual use. The Americans now believe that, although Britain has a big lead in the jet aircraft field, America will be saved much expensive research by profiting from results achieved by aircraft such as the Comet. They believe that radical changes in airport facilities will be required for the handling of the new planes.

Britains new turbo-prop airliner, the Bristol Britannia, is almost ready for test. It has a range of more than 5000 miles, cruising at 360 mph 30,000ft above the earth.

★ ★ ★

Atom planes

IN the back of most designers minds there is the possibility of using atomic power for propulsion which may completely alter the balance of "power" and the case for various types of power plants, particularly for aircraft.

Many accounts have been given of progress and problems in this field, but we are told that work has commenced in the US on the construction of an aircraft which will use an "atomic engine." It will be a very large bomber type, one reason being the weight of the protective shield which it is expected will be needed to protect the crew. The aircraft may eventually weigh something like 100 tons.

The project suggests that more has been done in the developments of nuclear-powered aircraft than has been revealed. This is by no means unexpected, for the value of such an aircraft is very great. The proposed leviathan, for instance, would be able to fly an enormous distance — estimated at 80 times

POPULAR SCIENCE QUIZ

A few more questions about the moon prompted by the recent interest in interpanetary travel.

Is there any similarity between the surfaces of the Moon and the Earth?

No. The surface of the Moon is characterised by extremely deep craters, high mountains, lack of soil and vegetation.

How do mountains on the Moon compare with those on the Earth?

There are some mountains higher than Mt. Everest, Earth's highest. The average would compare with the American Alps.

What is the temperature of the Moon?

The temperature extremes range from 200 degrees Fahrenheit above zero to 150-200 degrees below.

Is there more, or less, atmosphere on the Moon than on the Earth?

Less. There is no air on the Moon.

How does the Moon's gravitational pull affect the Earth?

It accounts for the rise and fall of tides of the Earth's oceans.

What color is the sky in Outer Space?

Always pitch black, day and night.

How do the stars appear in Outer Space?

Extremely bright, hard and unblinking. They are shining constantly even though the Sun's brilliance is blinding.

Is it always the same "face" of the Moon which is seen from the Earth,

Yes.

★ ★ ★

How does a fly walk on the ceiling?

This is something which has puzzled scientists for a long time, and even now it is not quite certain why the fly can do what we cannot do—walk upside down across the ceiling.

When the foot of a fly is seen through the microscope two membranes, or cushions, can be noticed, and these are covered with tiny hairs, each with a disc at the end. It is these discs which enable the fly to walk on the ceiling, but exactly how they work has never been settled.

Some scientists believe the discs act as suckers, and that when the fly walks on a ceiling a vacuum is formed between the disc and the plaster, and the insect is thus held up by the pressure of the air. Against this theory, however, is the fact that, when the air is drawn out of a vessel in which the fly is walking upside down, the insect does not fall off.

Other scientists who have studied the fly carefully believe it is able to hold on by means of a sticky substance coming from the underside of the foot. Each hair would seem to be a tiny tube for conveying this liquid from the little pouch in which it is produced, pouring it out as required.

★ ★ ★

Does sound always travel at the same rate as through air?

No, the lighter tne gas, the faster the sound travels through it, if the pressure and temperature are the same. If the air we breathe were hydrogen, instead of being a mixture of nitrogen and oxygen we should hear a clap of thunder much more quickly than we do. If a storm is four miles from us we hear the thunder about 20 seconds after we see the lightning, but if the air were hydrogen we should hear it about five seconds after the flash.

Here are the speeds at which sound travels in different gases when the temperature is at 0 degrees Centigrade, and the pressure is the same as the atmosphere at normal times: hydrogen, 4163 feet per second; air 1090 feet per second; oxygen, 1041 feet per second; carbon dioxide 856 feet per second.

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Aegis Mains Filter. Popular with every enthusiast!
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around the world — using 1lb weight of fuel.

* * *

Mike placement

WHY are ABC celebrity concerts spoiled by distortion which marred some of Gieseking's recitals, and at least one of those by the visiting Greek contralto? Although the level adjustments were obviously manipulated in both cases, there was no improvement.

The obvious suggestion is that there was overload taking place in the microphone amplifiers which being ahead of the first gain control, were beyond aid as far as the technicians were concerned. But surely it would not be too difficult to arrange the microphone placement a little more carefully than this, or even to provide for a slight movement while the concert was in progress.

Failing this, it should be possible to work out a series of placements to be observed by performers to make sure they do not approach too near the microphone. There are of course difficult characters such as the late Artur Schnabel and Sir Thomas Beecham who are likely to stage a sit down strike if not allowed to place themselves just where they please.

But it does seem that, after many years experience in these things, overload in a microphone channel could be avoided. It's not good policy to bring people half-way around the world to spoil their concerts in such a manner. The closer acquaintance which the public is getting with high quality reproduction via modern records is slowly making it much more aware of these things.

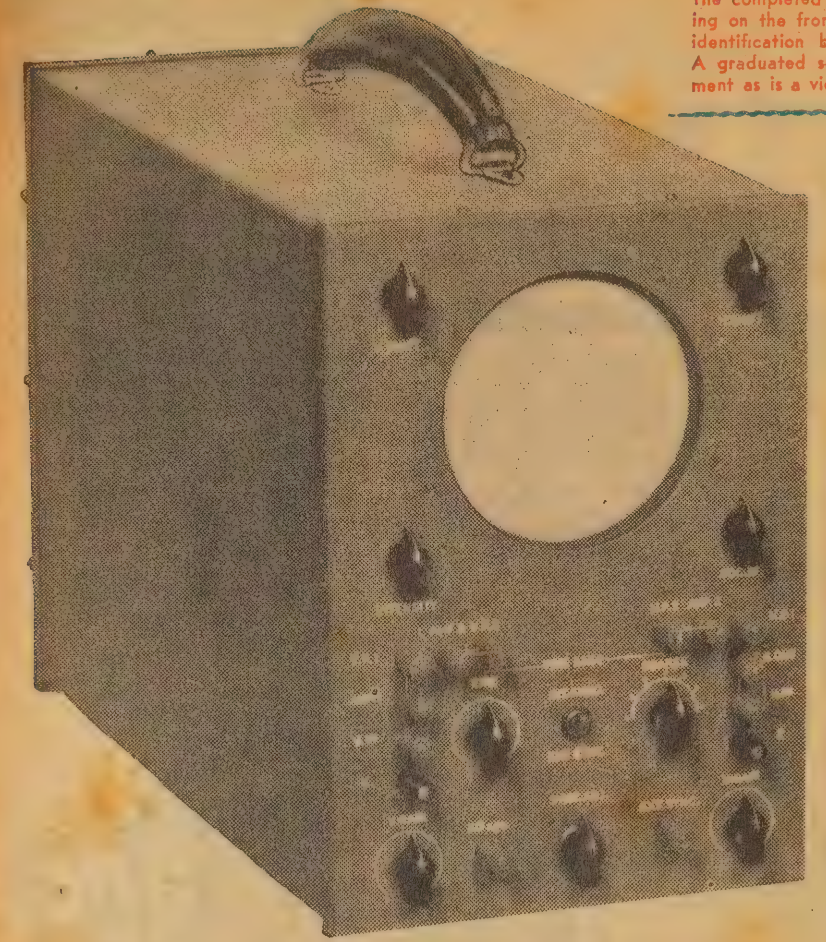
* * *

Making it hard

AND while we are having a good-natured winge about broadcasting, wasn't it rather hard to oblige any pianist, no matter how good, to commence recitals just when Walter Gieseking had departed after a sensationally successful tour?

That was a task which would have taxed the reputation and ability of any pianist alive. Maybe it wasn't possible to arrange booking dates otherwise, but it was a great pity. Gieseking was one of those rare artists who exercise the mind and the emotions almost to exhaustion. It takes a little time to recover one's wind after the experience of hearing him.

Would that we could say that of many other "celebrities" who undertake the colonial run when their best years are behind them! With all the best will in the world, we must be realistic in such matters. Australians who take their concerts seriously are quite capable now of considerable musical selection. Those who arrange performers and programs, as well as the performers themselves, should remember that. This is equally true of our own local efforts. Our recent season of opera had many good points. The critics were kind when they could be, and enthusiastic at the slightest encouragement. But from the listeners point of view, in our hearts we know we have a long way to go before we can even approach a really good performance.



The completed instrument in its case. The engraved lettering on the front panel affords logical control and terminal identification besides adding to the general appearance. A graduated scale over the tube face is a handy attachment as is a viewing hood for the removal of incident light.

We duly bought a complete case, panel and chassis over the counter, finished in grey brocade. The panel was sent off for the lettering to be engraved—a job which cost us about 30 shillings. The engraved letters were then filled with white enamel, using a lettering pen, and the result is shown in the photograph.

A properly lettered panel is worth a lot in an instrument of this nature, both for appearance and utility.

The most likely mechanical problems you will strike with the 5BP1, or any similar tube, is in connection with two items of hardware—the necessary socket and the highly desirable mu-metal shield. We got out of both difficulties by purchasing an ex-disposals radar indicator unit, which came complete with tube, socket and shield.

END SUPPORT

Apart from numerous wiring components, the radar indicator unit can provide yet another handy item, namely a rubber-lined collar, which supports the large end of the tube. Some such support is essential, for obvious reasons.

Unfortunately, this easy way out of these problems may not be open to everyone and other courses of action may be rendered necessary.

As far as the mounting collar is concerned, a satisfactory device can be made up from a strip of metal about an inch wide and bent into a circle just a little larger in diameter than the end of the tube. It should be provided with about four tabs, allowing it to be bolted in position behind the viewing hole in the front panel.

Line the strip with heavy felt, so that it provides a snug fit for the tube and prevents any possible contact between metal and glass.

The supply position of 11-pin sockets for the 5BP1 is not good, but, if the worst comes to the worst, it should be possible either to make up a workable socket or to solder the wires directly to the pins.

In the ordinary way, the socket merely floats at the end of the connecting wires and does not have to support the tube. A special bracket for this purpose is supplied as part and parcel of the Radio and Hobbies oscilloscope chassis.

We will have more to say later

BUILD THE NEW 5-INCH C.R.O.

Let's say you wanted to build a complete new oscilloscope for the ham shack, the service bench or the laboratory. How would you go about it? What tube would you use, what kind of circuitry? Well, here's our answer to these and many other such questions—a brand new design which is simpler than our last effort and able to do a better job.

THERE are many factors which influence the design of a CRO, but the most obvious is the choice of the tube itself. What size, what type?

For elementary work, a two-inch tube can be useful, but they are really too small for comfortable viewing. What's more, the stocks of cheap two-inch tubes, once available through disposals, have long since dried up.

As for three-inch tubes, there were never very many available cheaply, and, although you can buy them from new stocks, they cost real money.

Five-inch tubes would, of course, be dearer again were it not for the fact that there are still plenty of them around, selling for anything between 10 shillings and a couple of pounds apiece.

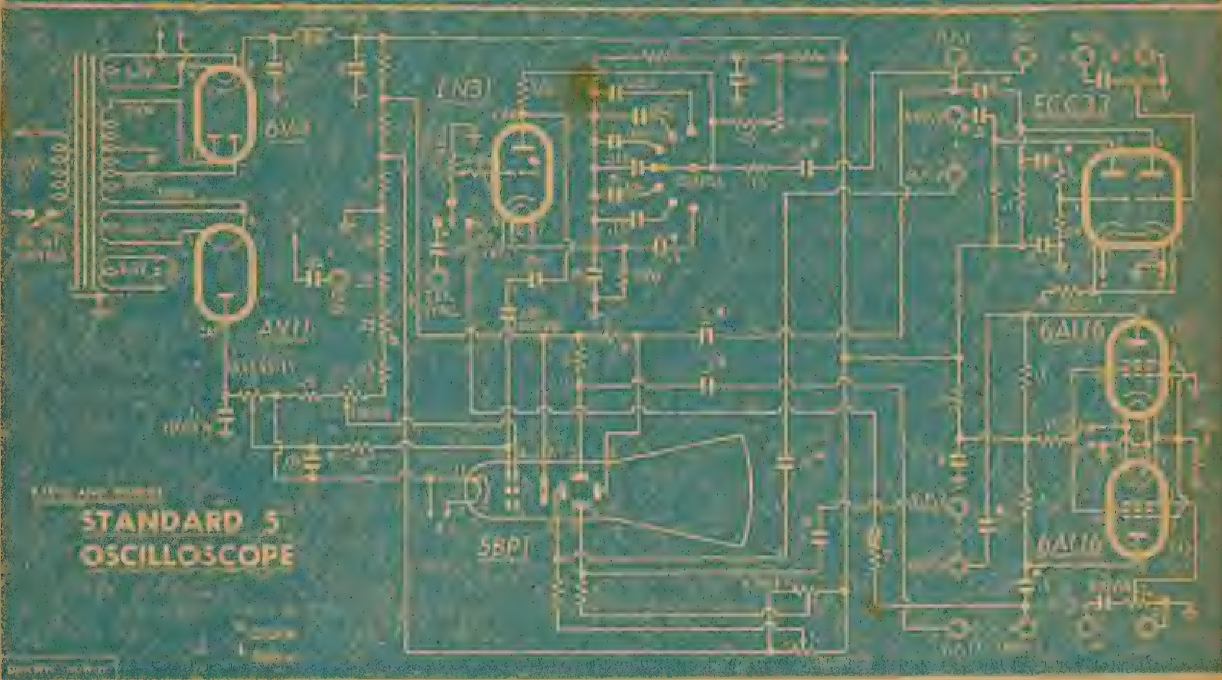
Sooner or later these stocks are going to dry up, too, but the valve people assure us that there are still several thousand tubes in the bulk stores which have not yet seen the light of day.

The choice, therefore, seems to be automatic — our new CRO must necessarily be designed for the 5BP1.

With minor changes, the circuit for a 5BP1 will also do for the many odd 6 and 7-inch tubes, which are floating around, and this is a further point in its favor.

Having decided on the 5BP1, the main physical features of the instrument follow almost automatically. It seemed logical to use the standard CRO cabinet and chassis, made available for our earlier design. A few additional small holes could be anticipated, but these should not present any great problem.

COMPLETE CIRCUIT OF THE FIVE-INCH OSCILLOSCOPE



Taken in appropriate sections, this circuit diagram is not as complex as it may appear. Viewing the circuit from the right-hand side will show the deflection terminals in the same relative position as they would appear on the front panel. The two terminals on each side of the EHT bleed circuit are those on each side of the "sync. adj." control on the front panel.

about the mu-metal shield and its significance.

On the electrical side there is room for a great deal of variation. At what voltage, for example, should the tube operate?

The finest trace and the one least influenced by external fields is produced by using the maximum rated EHT voltage of 2000. Against this, however, the lowered deflection sensitivity poses severe requirements on the amplifiers, together with the added cost of the power supply itself.

We felt, however, that the voltage as originally used could be increased to advantage by a small amount and we consequently arranged for a modified transformer design which would deliver 1000 volts RMS to the high voltage rectifier.

The effect of these additional volts, plus returning the shift and final anode circuits to the positive HT supply, produces an effective gun voltage for the tube of just under 1600.

TRANSFORMER SIZE

While on the subject of the power transformer, we examined with the manufacturer the possibilities of reducing overall dimensions and also leakage flux, which is ever likely to produce magnetic deflection of the spot.

By specifying a 6V4 instead of a 5Y3 for the low voltage rectifier, it was possible to eliminate one filament winding and save several watts in the process. This, together with special quality laminations, made possible the smaller size and the lower leakage flux which we were after.

Final measured figures on the power supply system gave 420 volts positive HT and 1330 volts negative filtered EHT.

From the HT supply, 315 volts are added to the 1330 making 1645 in all. About 55 volts are absorbed by the intensity bias control, leaving 1590 volts effective between cathode and gun.

Ordinary electrolytic capacitors are satisfactory for the lower voltage supply but for the EHT filter, something better than series-connected electrolytics are highly desirable. We suggest that you look for a paper capacitor 1 mfd or larger and rated at 1500 volts working or higher. New capacitors of this type can be obtained on order through trade houses but we have seen dozens of them displayed on disposals counters for a few shillings apiece.

The amplifiers are the next con-

PARTS LIST

Chassis 17½ in. x 8¾ in. x 5½ in.

Front panel 12½ in. x 9 1-8 in. (inside) with ½ in. flange.

Case 18½ in. x 9 1-8 in. x 12½ in. (outside).

Power transformer 350V a side at 20 mA, with one side extended to 1000V at 1 mA, 2.5V 1.75A, 6.3V 3A, 6.3V 0.6A (shielded).

1 filter choke, 30H 20 mA.

1 1-pole 12-position wafer switch, 1 single-pole-double-throw toggle switch.

2 octal sockets, 1 4-pin socket, 1 9-pin "innoval" socket, 2 7-pin miniature sockets with mounting plates, 1 11-pin socket for 5BPI.

VALVES

1 5BPI C.R.O., 1 AV11 (or 2X2/879) (H.V. half-wave rectifier), 1 6V4, 1 EN31 (gas-filled triode), 2 6AU6, 1 ECC33.

CAPACITORS

1 25 mfd 40PV electrolytic, 5 8 mfd 525PV electros., 1 1 mfd 1500VW, 8 .5 mfd 350VW (small imported type), 1 .1 mfd 600VW, 5 .1 mfd 350VW (small imported type), 5 .05 mfd 500VW (small imported type), 1 .01 mfd tubular, 1 .006 mfd tub., 1 .005 mfd tub., 1 .002 tub., 1 .001 mfd mica 1000VW, 1 500 pf, 1 30 pf air trimmer.

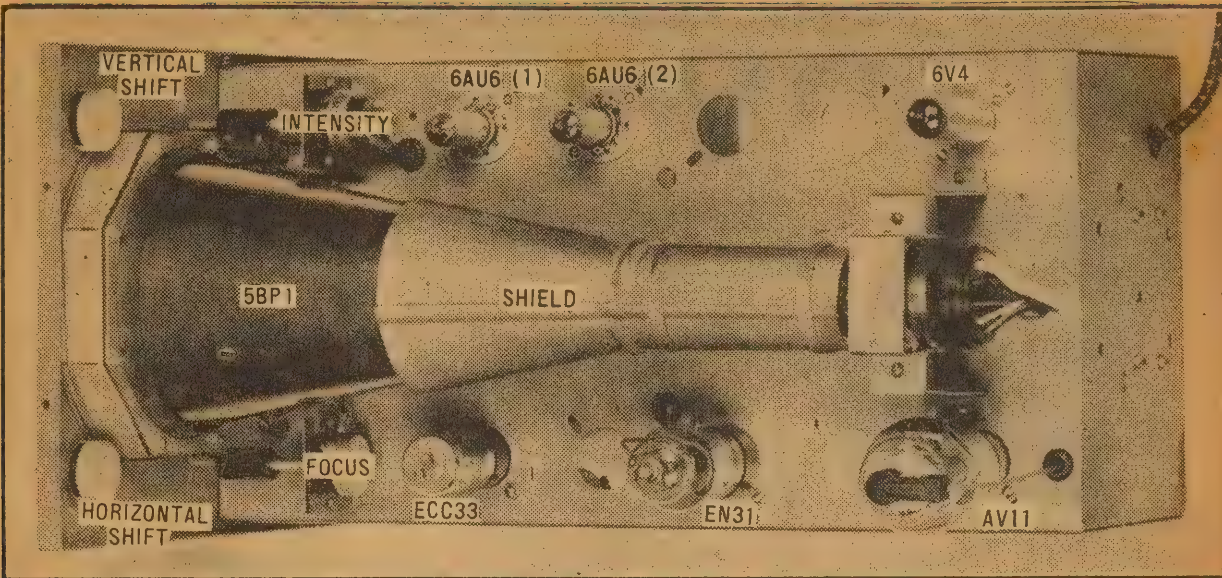
RESISTORS

5 2 meg 1W, 5 1 meg potentiometers, 2 1 meg ½W, 1 .5 meg 1 or ½W, 1 .5 meg potentiometer, 1 .25 meg potentiometer, 6 .25 meg 1W, 2 .2 meg 1W, 1 .15 meg 1W, 1 .1 meg potentiometer, (with single pole switch), 6 .1 meg 1W, 1 .04 meg ½W, 1 .035 meg ½W, 2 .01 meg ½W, 1 5000 ohm 1W, 2 1500 ohm ½ or 1W, 1 500 and 1 350 ½ or 1W.

SUNDRIES

9 pointer knobs, 14 terminals (12 red, 2 black), 5BPI screen mounting collar, 5BPI mu-metal shield, scrap aluminium for underchassis panel, 4 shaft couplings (2 insulated types), approx. 19in. ¼in. dia. rod, approx. 8 in. of resistor strip, 3 4-tag, 2 6-tag and 2 8-tag mounting trips, insulated cap for AV11, grid clip for EN31, 6 rubber grommets ⅜ in. i. d., 3 yds. 2 mill spaghetti, 9 to 10 ft. 16 or 18 SWG tinned copper, 4 rubber feet and carrying handle for case, power flex and plug, nuts and bolts, solder lugs, solder, hook-up wire.

ABOVE CHASSIS VIEW OF THE NEW OSCILLOSCOPE



This top view of the chassis layout indicates the suggested position for all valves. Note the insulated couplings and mountings for the "intensity" and "focus" controls. Wiring between the two shift controls is carried across the top of the 5BP1 front mounting collar. Sponge rubber or felt lining is used to line the support bracket at the socket end of the tube.

sideration and it is necessary to evolve a clear compromise between the results required and the degree of complexity which can be tolerated.

The natural urge is to aim for high gain, low noise, several megacycles of bandwidth and all the other features boasted by modern television-type oscilloscopes.

But have a look at the circuit of one of these and you'll most likely sit down for another think. There's a lot to them.

With a five-inch tube, there can be no doubt that push-pull deflection is highly desirable to preserve the symmetry and focus of the pattern at extremes of deflection. Thus, four tube elements are immediately necessary for the four deflector plates, together with some phase reversing circuit to allow the instrument to work with "single-ended" input.

Then again, if these deflection amplifiers are to have extremely wide frequency response, the plate loads must be quite low, while high-current, high-GM tubes are necessary to preserve some semblance of output and gain.

MORE TUBES

Once the amplifier design is approached on this basis, the number of auxiliary tubes is likely to be doubled at the very least, while the load on the main power transformer grows alarmingly.

To be consistent also, there is no point in providing extreme amplifier characteristics without, at the same time, expanding the performance of the time base. The "nice and easy" gas triode has to be passed by in favor of a multi-hard-valve system, with their often uncertain performance, circuit complexity and hard-to-get components.

In short, the results of pursuing the "performance - at - any-price" policy is likely to produce such an alarming array of components that the completed instrument is certain not to have popular appeal.

Our policy, therefore, has been directed in the reverse direction — how to make a good, conventional, general-purpose instrument with the fewest components and the least things to give trouble.

The vertical amplifiers are therefore a pair of 6AU6 pentodes, with one grid receiving the input and the other grid earthed. Cathode and screen coupling provides the necessary phase-reversal and push-pull output.

This simple scheme works remarkably well with high gain pentodes and the degree of unbalance between the outputs is not likely to be more than a few per cent. This is no practical consequence in an oscilloscope, because the beam automatically reacts to both the "push" and the "pull" influences and only gross unbalance would make an appreciable difference to the pattern.

FREQUENCY RESPONSE

On sine wave input, the vertical amplifiers are flat in the bass region to 20 cps, while, at the treble end, there is a gradual downward taper, with the gain controls at maximum, to minus 3db at 20 Kc.

The same taper continues to the highest observed frequency of 80 Kc, in which region there was also evidence that the amplifiers were overloading with a full-sized pattern, due apparently to capacitive shunting across the load.

These figures are completely consistent with normal audio oscilloscope design and are more than adequate for routine amplifier tests.

If serious work is contemplated with low-frequency square waves, it would be worthwhile to double or quadruple all coupling capacitors in the input to deflector-plate chain, since the time constant of coupling circuits must be extremely long for square-wave testing.

Admittedly, it would make matters easier in this respect if we could do away with the coupling capacitors but it would be at the expense of being able to get at the deflector plates from the front panel, an essential requirement for checking circuits operating at radio frequency.

We retained this arrangement of bringing the amplifier outputs to terminals on the front panel where they are bridged across to the appropriate deflector plate terminal. By simply removing these bridges, we can feed RF voltage direct to the plates, thus enabling checks to be made on transmitters and similar equipment up to frequencies approaching the 15 mc mark.

PARAPHASE CIRCUIT

Coming to the horizontal amplifiers, we reckoned that these are seldom used for anything else than for time-base purposes, or in linearity or trapezoid tests, where there is always plenty of signal available. It seemed logical, therefore, to use a twin triode for the purpose and save a valve.

We checked on the earthed-grid scheme, as applied to the 6AU6's but the balance was very poor. We reverted, therefore, to the familar paraphase arrangement, the component values suggested giving a balance quite adequate for the purpose.

You may wonder at the very large values of coupling capacitors specified for the horizontal amplifiers but these are essential if anything like linearity is to be preserved from the time base at the low frequency end of the scale.

We used imported 350-volt capacitors because they are smaller than the local 400-volt types but the latter would naturally be quite satisfactory from an electrical point of view. If you anticipate testing circuits with higher voltages than 400-odd, it would be wise to instal a 600-volt capacitor between the horizontal

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MULTITESTER RANGES. 1000 ohms per volt A.C.-D.C.

D.C. Volts	D.C. Current	A.C. Volts	Resistance
0-120 m.V.	0-0.6 mA	0-3	0.5-22.5-1000 ohms.
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

IMMEDIATE DELIVERY

MODEL 75A

RANGES 20,000 ohms per volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0—1000	0—1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.

MODEL 120A POCKET MULTIMETER

RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

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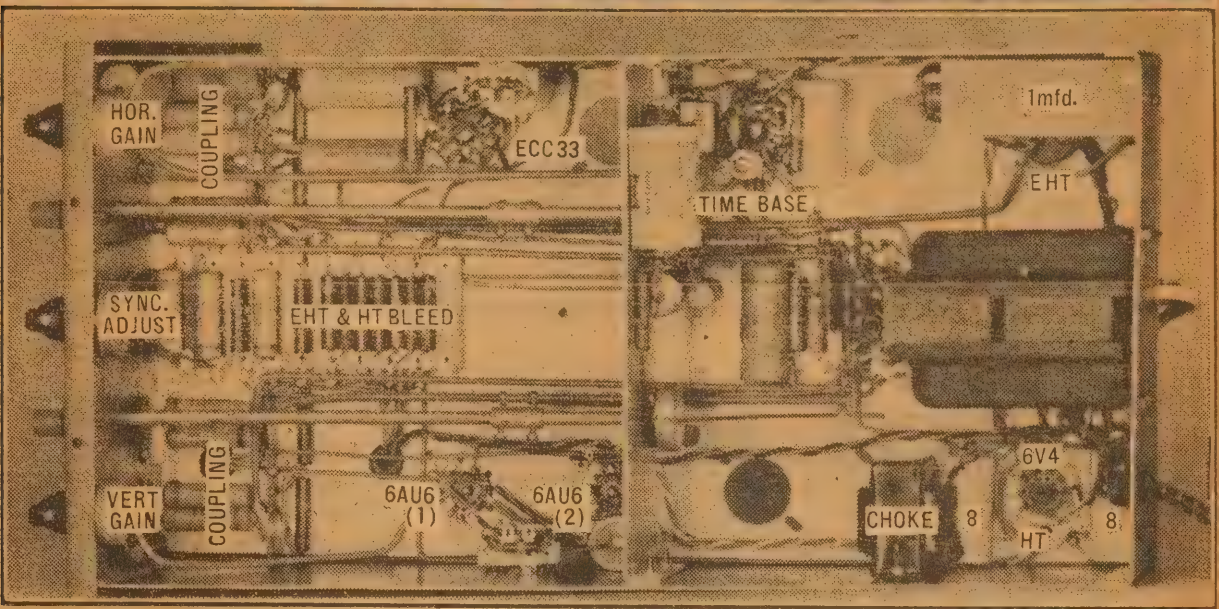
PLACEMENT OF THE PARTS BENEATH THE CHASSIS



Most constructional points raised in the text can be followed in this underchassis view. Don't be confused by the number of capacitors in the horizontal deflection wiring at the top left of this view because, in two instances, capacitors were paralleled to make up the desired value. You may find it necessary to alter the relative position of the transformer on the rear face to minimise residual magnetic deflection.

amplifier input terminal and its controlling pot. Please yourself on this point.

The time base circuit is a more or less conventional gas-triode affair, except that we have used an EN31 instead of the more familiar 884. The EN31 is credited with somewhat better high frequency characteristics but either will do a good job.

You can experiment with the exact value of the cathode bias resistor for the tube, as this controls the compromise between voltage output and linearity. The value selected with the particular gas triode used allowed plenty of output at the high frequency end, while giving quite good linearity at the low frequency end.

The unusual capacitor values shown in the wiring of the "coarse freq." switch can be made up by paralleling standard values. The parts list was drawn up on this basis.

LAYOUT OF PARTS

The only other major section of the circuit involves the bleed resistors and control pots. There should be no need to modify any of these values.

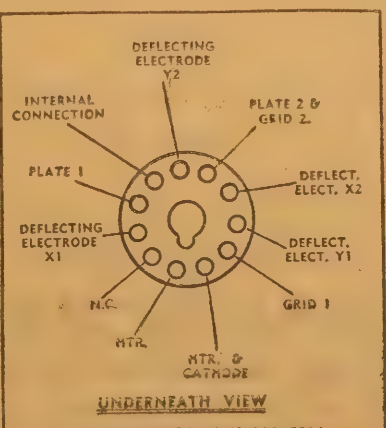
From the constructional angle, the position of all major components should be quite clear from the photographs. The whole aim in laying out the wiring and chassis has been to keep each section of the circuit entirely to itself, with the idea of avoiding capacitive leakage and random deflection.

The power transformer we used is mounted by four spade lugs and it is wise to keep outgoing leads fairly long, so that the transformer can be rotated later and bolted at any angle which may be necessary to offset residual magnetic deflection. Our transformer is shown in a regular position, but there may be differences between individual instruments in this respect.

The primary winding leads from the transformer connect to a 4-tag strip on the inside rear face of the chassis, allowing easy wiring to the switch mounted on the intensity control. Use a 3-core power flex to make connection to the power mains, using the green core to earth the chassis and case of the instrument to the mains earth system.

As mentioned earlier, it is highly desirable to fit a mu-metal shield around the tube. If one cannot be obtained it may be necessary to do some "plumbing" and to mount a felt-lined section of water pipe on brackets or long bolts on the chassis, such that it encloses the narrow neck of the tube at least.

The HT and EHT rectifiers are mounted on either side of the transformer, with the associated components immediately underneath. You will need to make up a mounting



UNDERNEATH VIEW

SOCKET CONNECTIONS FOR 5BP1

plate to fit the miniature 9-pin socket for the 6V4 into the 1 1-8in. hole in the standard chassis.

Great care must be taken with the EHT wiring to avoid risk of breakdown. Don't trust little bits of hook-up or single spaghetti layers where 1400 volts are at stake.

One of the spare pins of the AV11 socket can be used as an anchor-point for the lead from the AV11 anode cap. Incidentally, for safety sake, use an insulated type of cap clip for the AV11 anode connection.

LEADS TO TUBE

You will notice in the chassis kit that metal brackets are provided for setting back the intensity and focus controls behind the front panel. These controls operate at potentials of about minus 1400 volts and 1100 volts respectively and, to avoid risk of breakdown, it is advisable to insulate the frame of the pot and use an insulated coupling to the extension shaft protruding through the front panel.

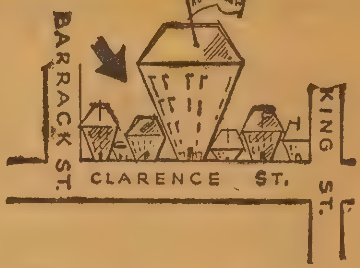
Most of the components to do with the EHT bleed circuit can be seen on the strip lying along the centre line of the chassis. The resistors are strung in series and wires run from junction points to the various controls. Once again, remember that any wires or lugs running at several hundred volts away from earth must be carefully and properly insulated.

All leads to the tube terminate on a 6-tag mounting strip toward the rear end of the short length of resistor strip in front of the transformer, flexible wires passing up to the CRO socket through two grommetted holes in the chassis. This insulation of the mounting foot of the strip provides another tag for the tube wiring and increases the breakdown voltage to adjacent tags.

Note that the deflector plate leads beneath the chassis are run in spaghetti-covered heavy busbar clear of all other components and well awa

Homecrafts

100 CLARENCE STREET



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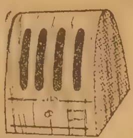

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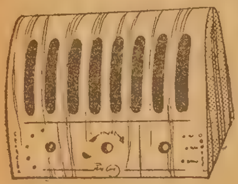

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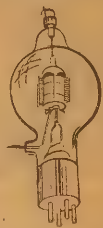

49/6

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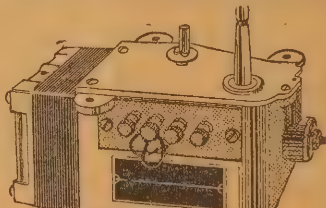

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All the above lines to be offered subject to prior sale as quantities are limited.

PLEASE ADD FREIGHT

HOMECRAFTS PTY. LTD.

100 Clarence Street, Sydney.

BX 4451, BOX 50 00, G.P.O., SYDNEY
ALSO 26 HUNTER ST., NEWCASTLE.

from the chassis. It is important that these should not be bunched in with heater and supply leads.

The time base components and switch are all grouped toward one side of a 3in. wide panel, which is bolted across the underside of the chassis. This procedure virtually eliminates stray leakage between the time base and other circuits.

The shafts of the time base controls are taken to the front panel through ¼in. extension shafts, where they pass through bearings salvaged from old potentiometers. In the earlier CRO design, these controls were mounted at the front panel, thus accounting for the size of the existing holes.

The variable trimmer shown between the time base output and the 5BP1 grid "blacks-out" the return trace or flyback. Too much capacitance, however, tends to upset the balance and focus of the forward trace at the high frequency end of the time base range.

The vertical and horizontal amplifiers and their associated components are grouped on the respective sides of the chassis, just in front of the shield carrying the time base components.

The coupling capacitors, which run to terminals on the panel and thence back to the deflector plate leads, are mounted in front of the sockets again. A pair of tag-strips half-way between the sockets and the front panel provide the necessary tie-points for the wiring.

TUBE FOCUS

From past experience, we have found that some CR tubes from disposals sources do not focus very well. While this is not very frequent, we are mentioning it so that it will not be confused with any residual magnetic deflection from stray transformer fields.

A check for deflection from such fields is to tie the deflector plate terminals to the earth terminal, shade the tube screen from incident light and adjust the intensity and focus controls for the best spot, keeping the intensity down to avoid damage to the screen material.

If there is any elongation of the spot, slowly rotate the tube in its supports and note whether the spot elongation remains on the same axis or whether it rotates with the tube. The former case indicates residual magnetic deflection and an axial position of the power transformer should be found where this deflection is at a minimum. The latter case indicates, in most instances, poor focusing in the tube.

It should be remembered at all times that too great an intensity of spot, trace or stationary pattern on the screen will, if left for too long, "burn" the screen material and seriously impair its ability to fluoresce at the part concerned.

Work on the instrument case involves the attachment of the usual carrying handle and four rubber feet. The blueprint for the case suggests provision of holes for self-tapping screws for the securing of the front and rear panels. If these holes are too large, a suitable alternative is to sweat 1-8in nuts over the holes on the inside face.

Apply just sufficient heat over the hole to "tin" the cleaned metal without charring the outside brocade. "Tin" the nut and hold it in place for sweating with a bolt passed through the hole and screwed half-way into the nut.

METERS

The following ex-disposals meters are available. The quality of all is excelent and they are all in new condition and of either English or American manufacture.

VOLTMETERS

0-20 volts with square case 2 inch type, can be converted for use in Multimeter if required.

Price only 19/6.

DUAL READING VOLTMETERS

Round 2 inch diameter type with two readings 0-20, 0-200 volts, ideal for testing batteries, radio or automotive repairs, etc.

Price only 17/6.

DC MILLIAMETERS

0-50 mA with square faced 2 inch diameter case, a very handy meter at a reasonable price.

Only 18/6.

R.F. AMMETERS

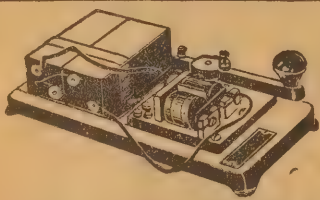
In 3 sizes these are 2 inch diameter type and are priced as follows.

0-.5 amps round type 22/6
0-2.5 amps square type 22/6
0-3 amps round type 22/6

METER RECTIFIERS

Ex U.S. Army 1 mA full wave, will work successfully on 5 mA. Extremely small physical size. Brand new easily worth 35/-.

Our price 17/6 each.



Learn the Morse Code with this cheap efficient equipment.

Morse Practice Sets (illustrated). Built on solid base of either metal or wood, these have double adjustment on buzzer, efficient key, new 3 volt batteries, connections for line and are especially designed for the beginner to learn the code. Made in England, brand new and boxed. These are worth easily 45/-. **Our Price 18/6 each.**

Also available a few Australian secondhand morse practice sets with new batteries. **10/6.**

Morse keys (Army type), 2/11; Morse keys (Flameproof Aircraft type), 6/6; Morse Buzzers (Army type) with two adjustments, 4/6.

AT300 TRANSMITTERS

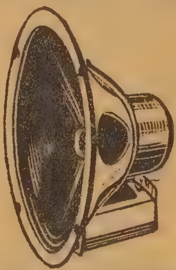
Radar Transmitter uses the following parts:—
2-AV11 Valves, 2-Cyclatron Valves, 2-4 Ceramic Socket, 1-24 Volt Motor, 2-.01-5000 Volt Working Condenser, 1-.02-10000 Volt Working Condenser, 1-.001-5000 Volt Mica Condenser, 3-Heavy Duty Transformers, 1-0-100 Volt A.C. Meter which is 0-1 mA movement with 1 mA dry metal rectifier fitted, 1-0-5 mA D.C. Meter and many other parts such as stand off insulators, coils, etc., easily worth £20.

Our price £4/19/6

SPECIALS!

100 mA Power Transformers 285 aside 5 volt and 6 volt. Windings 32/6 each.
100 mA Power Transformers 385 aside 2.5 volt and 5 volt also 6 volt Windings 35/- each.
Lid Stays for Radiogram. Normal price 5/-. **Our price 2/9 each.**
Shielded Belden hook up wire. Outside covering lacquered woven cotton. Ideal for car radio work and microphone cables. Easily worth 2/- yard. **Our price 9d yard.**
Voltages Dividers — well known brand both 15,000 and 25,000 ohms. Worth 6/6. **Our price 2/9 each.**
Job Rola. 2.3 Speaker Transformers 5000 ohms input. Usual price 15/-. **Our price 6/10.**
Job line of 12/50 chokes. Usual price 12/3. **Our price 2/6.**
Job line of Midget Speaker Transformers to suit 3 ohms voice coil suit 3½ and 5 inch speakers. Input 5000 ohms. 4/6 each.
A few only No. 11 High Voltage Genemotors. 12 volt input 345 volts at 40 mA output. Worth £5 each. **Our price 27/6.**
A few only CW 46048 D Aircraft radio receiver units less valves and coils but with vernier drive and 4 gang condenser and other parts.

Our price to clear 22/6.



6 INCH SPEAKERS

Best known make of English Speaker complete with 5,000 ohms transformer brand new and boxed.

Price only 29/6.

RHEOSTATS

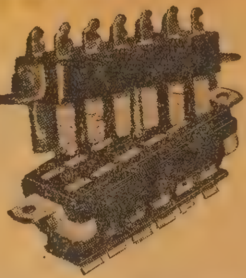
Bargains in heavy duty rheostats I.R.C. 250 ohm 25-watt wound on Mica and porcelain insulated as illustrated.

Price 4/6.

100 ohm Heavy Duty Rheostat as used in English Aircraft.

Price 2/3.

All parcels sent Registered post unless otherwise stated. Postage on freight must be included with order.



JONES PLUGS AND SOCKETS

As illustrated. Available in following sizes, all brand new and in perfect condition.

6-pin, 5/6. 8-pin, 5/6. 12-pin, 8/6.

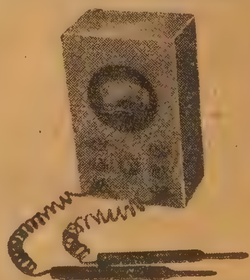
Monarch Vibrator Mantle 4 Valve Broadcast

(as illustrated)

This little bakelite mantle set uses a separate vibrator unit which can be placed on the floor with the battery thus eliminating vibration noise, etc. With a reasonably good aerial and earth the tone and performance is remarkable and all interstate stations can be logged at night.

We are sacrificing these sets for 22gns. Battery extra.

Also available is the 5 valve Dual Wave Monarch similar to above only larger in Walnut Bakelite Cabinet. 29gns. Battery Extra.



CHIEFTAIN MULTIMETER

The ideal pocket size meter for measuring voltages of electrical circuits and checking continuity of circuits, etc., Volt Scales 0-15, 0-150, 0-300, 0-600, D.C. Ohms Scale 0-50,000. The cheapest and smallest on the market. Complete with prods and battery, can be carried in your coat pocket with ease.

Price £3/19/6

MOTOR SPARES LTD.

547 ELIZABETH STREET, MELBOURNE

ATOM POWER FOR AIRCRAFT

(Continued from Page 7)

However, every effort must be made to keep down the weight of the shield and reactor, such as by making the reactor small so that the shielded volume is kept small.

However, this restricts the amount of cross-sectional free-flow area through which coolant may pass through the reactor, and increases the pressure drop. Moreover, as the reactor diameter decreases, it is usually found that more fissionable material is required, which is undesirable. Hence, some sort of balance must be struck.

The existence of a large concentrated weight, such as the shield and reactor at one point in an aircraft, makes it necessary to redesign the structure of the aircraft to accommodate this weight.

WEIGHT CONSTANT

Because of the small amount of fuel consumed in flight, the weight of the craft on landing is about the same as on the take-off; hence, the landing gear must be made stronger.

Also, the landing speed is increased, and there may be a change in landing attitude which could possibly require changes in the landing gear or in tail clearance angle requirements.

The essence of a nuclear power plant is the transfer of heat from the reactor to the propulsion machinery. The requirements for small size and high power density placed on the reactor, push the heat-transfer designer to the limit of his knowledge.

He must avoid hot spots in the flow system, must have good flow distribution, and must know exactly how the power is distributed in the reactor so that the proper amount of coolant can be applied to key parts.

Finding the correct materials for reactors is one of the man problems. The combined effects of high temperature, corrosion by various coolants, radiation damage, thermal stresses, and mechanical stresses, can be serious.

EFFECT ON THRUST

Thus, a difference of 100deg F in permissible maximum reactor temperature can easily produce a 15 pc difference in the thrust output of the power plant. Materials that will withstand high temperatures are a prime necessity.

A corrosion-resistant coating, a few thousandths of an inch thick, on the reactor heat-transfer surfaces may double the critical mass.

A brazing alloy containing a small percentage of boron (a strong neutron absorber) may put so much boron into the reactor that it cannot be made to go critical, and this particular alloy may therefore be entirely unusable.

An alloy high in nickel, for use as a reactor structure, may have good resistance to corrosion and high temperatures; but it may be so strong a neutron absorber as to necessitate substitution of another alloy of lower nickel content with less strength and less resistance to corrosion.

In recent months, the Government has announced that the nuclear aircraft program is entering a new phase. In this new phase, the aircraft gas turbine department of the General Electric Company has been given the responsibility for the propulsion system, and the Consolidated Vultee Aircraft Corporation is to supply the airframe.

SPECIMENS 'PLATED' FOR MICROSCOPE

A NEW, low-cost shadowing unit to speed preparation of "shadow-cast" specimens for the electron microscope has also been developed by RCA.

The new apparatus permits laboratory personnel to deposit a thin coating of tungsten, molybdenum, or other suitable material by evaporation on as many as six glass microscope slides at one loading in the all-metal vacuum chamber. The specimen contrast is enhanced and the third dimension usually made evident.

The unit consists of a small, steel vacuum chamber which can be evacuated at high speed. Eliminating the handling of heavy, fragile bell jars, the equipment provides ease of specimen insertion. Specimen slide-holders provide a wide range of shadowing angles without filament adjustment.

Here's your answer, Tom!

Every so often, Tom brings to light some of the diehard fallacies about electrical matters. For example there is a popular idea that the bigger an electrical device the more current it will consume by which reasoning a radio set must necessarily consume more power than an electric light globe or an electric iron. In answering Tom's first query we show how to calculate the power consumption of a radio and give typical figures.

WHILE on the subject of popular fallacies, we heard a story about a dear old lady who religiously switched her otherwise unused radio on for five minutes each evening with the idea that it would last longer if used regularly.

There is another one about lightning never striking in the same place twice. Of course you could agree cynically that the "same place" isn't there a second time!

But to continue with Tom's queries:

However much does it cost to run an average radio set and is it cheaper or dearer than an ordinary electric light?

The tone of your question would suggest, Tom, that you are the victim of a landlady with characteristics popularly attributed to people of Scottish descent.

The cost of operating a radio or an electric lamp depends on the amount of power it consumes and the length of time it is in operation. Popular sizes for electric light globes are 60, 75 and 100 watt but the amount of power used by a radio cannot be arrived at so easily.

In the absence of a special meter to measure the AC power input to the receiver it would be necessary to find the sum of the powers consumed by individual sections of the receiver.

Naturally, we can't work out the power for every possible receiver that you are likely to have but a good example of a modern standard receiver is the 1952 "Advance" which was described in the January 1952 issue of *Radio and Hobbies*. Small mantel receivers will probably take less while sets with RF stages and push pull output stages will take more.

The "Advance" has 4 valves which operate with 6.3 volts applied to the heaters and which require a total of 1.54 amps. The power, therefore is 6.3 multiplied by 1.54 which equals 9.7 watts. The rectifier valve requires 5 volts at 2 amps or 10 watts. Therefore the total filament power is 19.7 watts.

In this particular receiver the high tension supply delivers 250 volts at 60 milliamps or 15 watts. Allowing another 5 watts for the losses in the rectifier and filter system we arrive at a total figure of 39.7 watts, unless you like to add another couple of watts for the dial lamps.

The efficiency of the average receiver power transformer is about 85 pc so that the total power taken from the main is 39.7 multiplied by 10 and divided by 8.5 which equals 47 watts approximately.

OTHER SETS

Some of the older radio sets which are equipped with field coil type speakers rather than those excited by a permanent magnet will require slightly more power. The extra load, including the losses in the transformer, is not likely to amount to more than about 10 watts which would bring the total power up to 57 watts.

From this we can make the general statement that the power consumption of a radio receiver likely to be somewhat less than that of an electric lamp. Only in the case of a large receiver is the lamp's consumption likely to be exceeded.

Most electric power distributors sell current on the basis of so much per kilowatt hour. Possibly with a desire to keep the meter manufacturers in business, some concerns install separate meters in the circuits used for lighting and those used for power and charge at a greater rate for lighting current. In this case it would cost you more to operate the radio from a light socket than from a power socket.

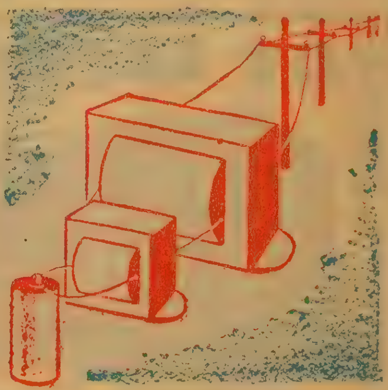
Anybody who tries to be smart and operate his lights from a powerpoint likely to incur the severe displeasure of the power company and so save on his electricity bill is

What appears to be a more rational system is one in which only one meter is used and a flat rate charged for both electric light and power. However, to cover administrative costs where the power consumption is small a greater charge is made for the first few kilowatt-hours.

In one particular case, you may be charged 6d per kilowatt-hour for the first 20 kilowatt hours and 2d per kilowatt-hour for any electricity you use thereafter during the quarterly period.

In order to work out the average cost of the electricity it would be necessary to know the amount of the particular bill as well as the cost for primary and secondary kilowatt-hours.

Assuming for the sake of convenience that the radio requires a total of 60 watts it would cost 0.36 pence to operate the radio for one hour at the primary rate but only 0.12 pence per hour to operate at the secondary rate. In other words, at the secondary rate you could operate a radio for over 8 hours for 1 penny. Cheap entertainment!



Would you please tell me where the power comes from in a step-up transformer and where it goes to in a step-down transformer.

We would like to get hold of a few of these step-up transformers, Tom, preferably a whole series of them starting with a very small one operating from a torch cell which could feed into a larger one which could, in turn, feed into a still larger transformer and so on until finally there was enough power to light the whole countryside. All from a torch cell!

Of course you could do away with the torch cell by taking out some power somewhere along the line and feeding it back into the beginning of the system!

Unfortunately, Tom, there is a fly in the ointment as far as this otherwise very bright scheme is concerned. There are no such things as trans-

formers to step up power level. The very best of them actually waste power.

Transformers are merely a means of changing a low voltage at high current to a high voltage at a low current and vice versa. The power (calculated by multiplying the voltage by the current) is the same, or if anything slightly lower, after passing through the transformer.

For example a transformer may have 240 volts at 1 ampere fed into its primary and from its secondary deliver 6 volts at 40 amperes or a little less. The "little less" is accounted for mainly by heat developed in the transformer due to the fact that it is not possible to make wire without resistance. There are losses also in the iron core.

If 6 volts at 40 amperes are fed into the same transformer, it will deliver a little less than 240 volts at 1 ampere.

Incidentally, ordinary transformers will only operate with alternating current. In the case of direct current it is necessary to use a rotary transformer or some other device usually mechanical in nature. For this reason alternating current is the more convenient for power distribution.

I am a bit puzzled as to why some valves which appear exactly alike in the circuit diagrams have different uses. For instance, the 2A3, 6A3, 10, 12, 20, 30, 40, 50, 01-A, 1G4-G &c, all appear the same. In what ways are they different?

In much the same way as dogs can have four legs, a nose and a tail and be different so radio valves can have a filament, a grid and a plate and be different.

To use the examples you have given, the 2A3 has a filament designed to operate from 2.5 volts. It has a large filament, grid and a plate so that it can handle relatively large amounts of power and these components are so placed with regard to each other that the valve has a low plate resistance, this feature being desirable in a valve designed to feed a loudspeaker.

A 6A3 is exactly the same except that it has a 6.3 volt filament.

Filaments rated at 6.3 volts are used in most modern receivers, so that the 6A3 is often more convenient to use nowadays. As a matter of fact, there is a type 6B4-G which is the same as the 6A3 except that it is fitted with an octal base rather than one of the 4-pin variety.

MORE EFFICIENT

Some of the valves you mention are types that have since been replaced by others able to do the same job more efficiently. They are included in the valve data manuals for the benefit of people doing maintenance work on old equipment. The 01-A for example has a very inefficient filament high on its list of defects when compared with the latest types able to do the same job.

As you go on you will become familiar with the various types and they will fit into a general ordered picture in your mind.

Besides providing more electrone for the plate, what are the effects of 12.6 volt filaments in valves in place of the more usual 6.3 volt filaments?

You seem to have started off on the wrong foot, Tom, and if you will allow us to take a guess we would say that the root cause of your problem is that you are not very clear on the significance of the word "volt."

ELECTRICAL UNITS

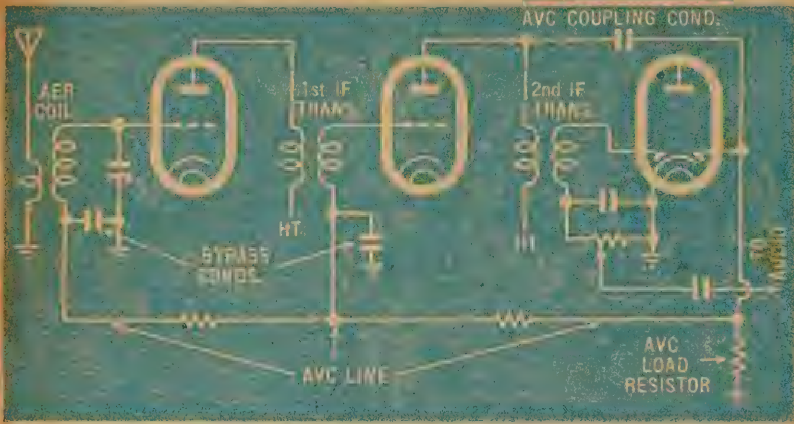
The volt is a unit of electrical pressure. If you were considering the flow of water in a pipe, the analogous unit would be the pound per square inch. The ampere is the unit of electrical current and the power, or amount of electrical energy dissipated in a given time, is obtained by multiplying the voltage by the current. The figure thus obtained is so many watts.

In the case of a valve with a separate cathode and filament, the purpose of the filament is merely to heat the cathode to a temperature at which it emits electrons freely.

In general, therefore, it is possible to have a particular style of valve with any filament voltage within certain limits. These limits are imposed by the thickness of the leads toward the low voltage end and difficulties with insulation at the high voltage end.

Valves with 12.6 volt filaments were used extensively in aircraft equipment during the war because aircraft power supplies are usually of higher voltage than car and truck supplies.

(Continued on Page 91)



This simplified circuit of an AVC system should help you to grasp the basis principles. Note that the grid circuit of both controlled valves returns to the AVC line which is maintained at a negative voltage generated by the incoming signal. The diode on the right rectifies the RF signal.

Another source of signal variation is faulty house wiring, and this is most obvious with old installations where conduit has developed rust at its various joints. The trouble is aggravated by the almost universal habit of using a few feet of wire strung around the picture rail in place of an aerial, under which conditions the signals reaching the set have come mainly via the power lines.

The result is that vibration, such as wind or passing traffic, can cause crackling and variations in signal strength as the conduit joints are disturbed. Operation of light switches, by altering the amount of wire in circuit, can have a similar effect, especially when the circuit happens to run near the aerial.

Unless something is done to offset these variations, the volume will fluctuate from much too soft to uncomfortably loud, and no one likes to be continually jumping out of a comfortable armchair to adjust the volume of a favorite program.

LEARN WHILE YOU BUILD

With the completion of the multimeter, our "Learn While You Build It" series is drawing to a close, for a while at least. Before we finish, however, we are reverting to the "Superhet Four" and describing a relatively simple and inexpensive modification to bring it up to date.

by Philip Watson

EXCELLENT though the performance of this set has been—and we have had many reports to confirm our expectations—it still lacks one important feature which is found in most modern sets. This feature is automatic volume control or, as it is usually expressed, AVC.

Now, just what is AVC, why is it desirable, and how does it work?

All right, then, let's take those questions in order.

The first one, "What is AVC?" is almost, but not quite, answered by the name itself. AVC is a system of circuitry whereby the volume, that is, the average volume, given out by the loudspeaker is maintained essentially constant in spite of variations in the strength of the incoming signal.

NATURE OF CONTROL

Note that we say the average volume is maintained constant. The reason why this point is emphasised is because some beginners imagine that the instantaneous volume will come under the influence of such a system so that loud and soft passages of music will be affected and the contrast between them destroyed. However, as we shall see presently, it is only the carrier strength of the signal, not the depth of modulation, to which this system responds.

The next part of the question, "Why is it used?" is a somewhat longer story. It is fairly obvious that any variation in signal strength reaching the receiver will cause an undesirable change in volume from the set, so part of the discussion is really a survey of the reasons why signals change in strength. However, there is also the aspect of receiver design and how it is affected by the use of AVC, something which is often overlooked in explanations of this kind.

For the city dweller, and probably most of the owners of the Superhet Four, it is the variations in strength from station to station which are most obvious.

It often happens, for example, that most of the local stations are some considerable distance from the reception point and produce moderate, easily-received signals; at the same time, one or two stations are very much closer (and sometimes much more powerful), giving signals which may be hundreds of times stronger.

Under these conditions, tuning from a weak station to a strong one will result in a blast of volume which threatens to destroy both the speaker and the listener's eardrums. This sort of thing can be very unnerving, particularly for the non-technical listener, who generally jumps to the conclusion that the set is about to blow up. While this is unlikely, it is true that severe overloads are not good for a speaker, and the smaller speakers are easily overloaded.

Then, again, in country areas, reception is often over very long distances and the signals reaching the set are often what are known as "sky waves." These are waves which started out from the transmitter at a high angle and which have been reflected from the Heaviside layer back to the earth at a distant point. There is quite a lot to the study of this aspect of transmission, but sufficient to say that such signals vary considerably in strength, a phenomenon known as "fading."

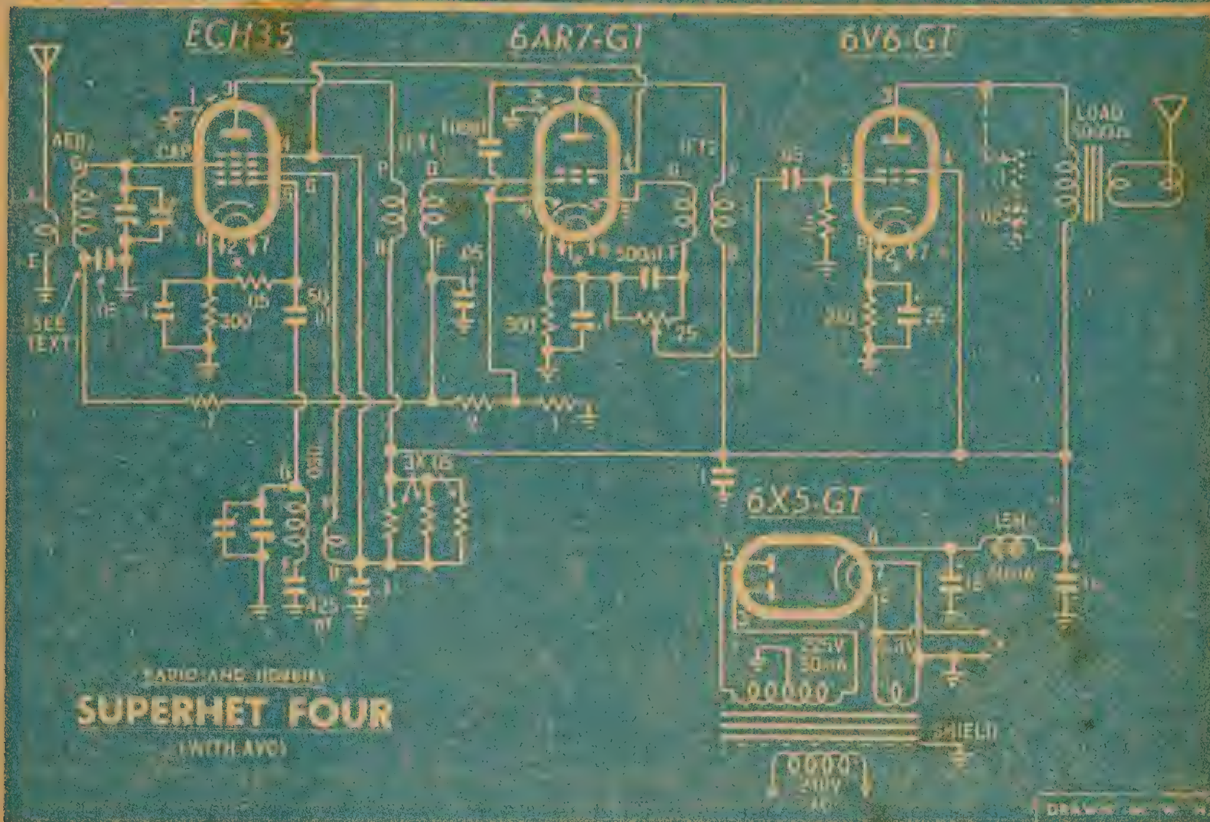
FADING PROBLEMS

At broadcast frequencies, a fade may occupy several minutes, the signal sometimes becoming inaudible or badly distorted but, in the main, remaining audible providing the volume is continually adjusted. Since such continual adjustment is inconvenient, to say the least, reception of such signals is generally considered not worth-while.

All the foregoing, of course, adds up to a very good case for AVC. With a set having this feature the variation in strength between stations, at least within the "local" radius, is largely eliminated and, at most, only a small adjustment of the manual volume control will be needed. Likewise, changes due to faulty wiring, &c, are generally so effectively offset that, for all practical purposes, they cease to exist.

The fading experienced on long distance reception is also minimised, although it would be wrong to imagine that all fading troubles are automatically overcome by the use of AVC. Providing the signal remains free from distortion and above

THE "SUPERHET FOUR" WITH AVC & TONE CONTROL



The complete circuit of the modified receiver. Only a few extra components are required and comparison with the original circuit should enable the reader to pick out the modifications. The .05 mfd bypass condensers provide an RF path to chassis and also control the time constant of the system.

the prevailing noise level the set will take care of most variations, but more than this cannot be expected.

If the signal drops too low, the effect is as if the noise level had risen to swamp the signal while distortion which previously passed unnoticed because the signal was too weak will now be glaringly obvious.

Nevertheless, there are many cases when the existance of AVC will make all the difference between a signal which is worth listening to and one which is not. For short wave reception, where fading is rapid and usually continuous, it is virtually essential.

CONTROLLING LEVELS

However, there is another aspect of AVC, and one which would justify its use even if there were no other advantages, and that is its ability to maintain correct levels of signal throughout the set without a multiplicity of controls — and a trained operator to adjust them.

In the case of the "Superhet Four" and similar small sets this problem is not very serious, due to the absence of any audio amplifying stage but, in a five valve set or larger, it presents a real problem. It really boils down to a question of where to locate the volume control; before or after the detector.

If it is placed before the detector it will be in the form of a variable bais control on the convertor and IF amplifier valve (as in the original Superhet Four) thus limiting the strength of signal applied to the detector. Diode detectors, which are almost universal today, require a fairly high signal level fed to them if they are to produce a minimum of distortion and this condition is easily fulfilled in the smaller sets because the limited audio gain makes a high input essential if the output is to be sufficient.

However, as soon as we add an audio stage, we find that the gain following the detector is so high that normal listening volume is produced long before the detector is adequately loaded, thus resulting in higher distortion levels. This can be overcome by shifting the volume control to a position after the detector (as in the present circuit) where it effectively reduces the gain of the audio section and allows the detector to be adequately loaded.

EXTRA PARTS

- 1 .25 megohm potentiometer
- 1 2 megohm ½ watt resistor
- 1 1 megohm ½ watt resistor
- 1 .1 megohm ½ watt resistor
- 2 .05 mfd 200V paper condensers
- 12" shielded hook-up wire
- 1 2-terminal tag strip, spaghetti sleeving, etc.

Under these conditions the stages ahead of the detector will have to be allowed to operate "flat out" if the maximum gain of the set is to be available when required. This leaves this part of the set wide open to overload when a powerful local signal is encountered, the level after amplification by an early stage, say the converter, being too great to be handled by the following stages without serious distortion.

The natural suggestion, of course, is to fit volume controls both before and after the detector, thus allowing each section of the set to operate under conditions of optimum signal strength. This is quite a logical suggestion and an excellent idea apart from one snag—it is virtually impossible to train the average non-technical user to juggle two volume controls with due regard to all the factors we have just discussed.

VALVE CHARACTERISTICS

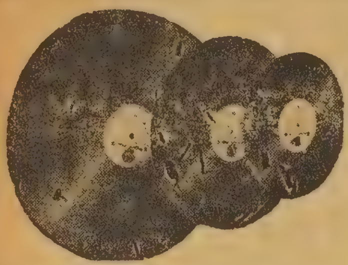
By fitting AVC we provide an automatic means of controlling the stages ahead of the detector and ensure that the latter will always be working under favorable conditions, while the manual control may be located in the audio circuit where its setting is not particularly critical.

Which just about answers the question "Why is AVC used?" It brings us to the next one, "How does it work?"

In order that you may be able to understand this fully we must

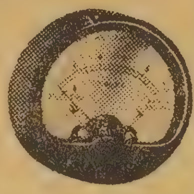
Homecrafts PTY. LTD.

BARGAINS FOR THE RADIO ENTHUSIAST!

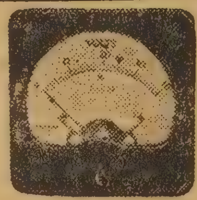


B.R.S. RECORDING BLANKS

High grade Recording Discs with highest quality aluminium base. Available in three sizes, as illustrated. 8in 6/11, 10in 8/4, 12in 9/11, 16in 20/9.



English 0-1 DC Ma. Moving Coil 2in scale Meter. Brand new in original carton. Only 29/11



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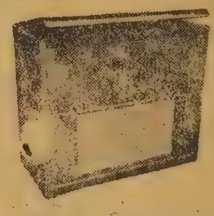

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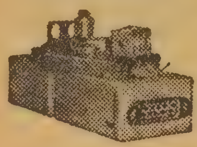
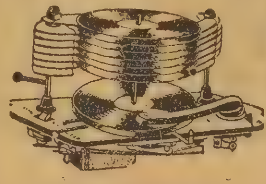


Car Radio Kit, as described in "Radio and Hobbies," March, 1952, issue. Karset complete to the last nut and bolt including 6in. Rola Speaker and Box. Price including sales tax, £24/12/6.



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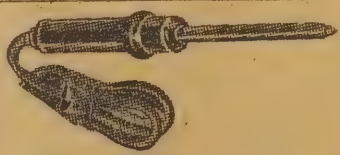

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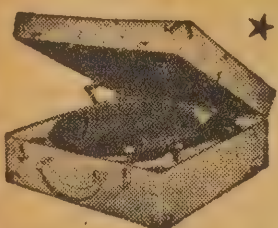

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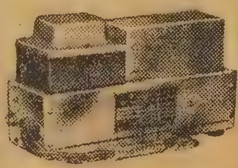

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reiterate some remarks we made in an earlier article, December, 1951, to be exact, about variable-mu valves. These are valves in which the effective stage gain can be varied, the exact value being determined by the negative voltage applied to the grid. Thus, by making the grid increasingly negative the effective stage gain is reduced to a very small fraction of what it is when the valve is operated with minimum bias.

This characteristic was used in the original "Superhet Four," the bias on both the ECH35 and the 6AR7 being varied by means of the 10,000 ohm manual volume control. This same characteristic is used when AVC is applied, the difference being mainly in the manner in which the negative control voltage is generated.

Since the controlling voltage must bear a definite relation to the strength of the signal it is to control, i.e., a large control voltage for a strong signal and a small voltage for a weak one, it is a logical suggestion that we use the actual signal to generate the control voltage and, in fact, this is exactly what is done.

GENERATING THE VOLTAGE

Figure 1 may help you to grasp just how it is done. You will notice that the lower end of aerial and IF secondary windings is no longer connected to the chassis, but connects to a resistor combination known as the AVC line. This means that whatever DC voltage is present on the AVC line will be applied to the grids of the valves, while the condensers from the bottom of each secondary to chassis serve to complete the RF circuit by making this point effectively at chassis potential as far as RF voltages are concerned. They also serve another purpose, as we shall see presently.

Next step is to actually generate the required DC voltage from the incoming RF signal, and, for this purpose, use is made of a diode rectifying circuit similar to that used for detection. In fact, some circuits use the one diode for both detection and AVC generation, but it is easier to grasp the idea when separate diodes are considered.

Whereas the detector diode is fed from the secondary winding of the IF transformer the AVC diode derives its signal from the primary, connection being made by means of a small mica condenser. Main reason for this is to avoid the slight reduction in signal strength present in the secondary due to the loading by the detector circuit, it being desirable to keep the AVC voltage as high as possible.

ACTION OF THE DIODE

Connected between the diode plate and chassis is a load resistor across which the AVC voltage is actually generated. If you ignore, for the moment, the connection to the diode plate it is easy to appreciate that the IF voltages present between the plate of the valve and chassis will also be applied to this resistor.

However, when the diode is connected it will provide a low impedance conducting path in parallel with the load resistor every time the diode plate is made positive, the net result of which is to generate very little voltage across the load when the diode is positive, but practically the full IF voltage on each negative impulse.

Thus there appears across the load, and on the AVC line, a pulsating negative voltage having a frequency equal to the IF and a value dependent on the strength of the incoming signal at any instant. This is not quite what we require, since the control voltage needs to be a steady DC, which will not vary with the instantaneous variations in carrier strength, as caused by the modulation, but only to relatively slow changes due to fading, &c.

The final filtering of the pulsating DC to steady DC is performed by the by-pass condensers on each secondary winding, the values being so chosen that a relatively long time (a substantial fraction of a second) will be required to discharge them appreciably. If these are too small the slower variations of modulation, representing the bass notes, will encroach on the control system, causing a reduction in bass response, while, if they are too large, there is a danger that the system will not respond rapidly enough to follow fading signals.

In receivers designed expressly for short-wave reception it is usual to make the AVC response fairly rapid in order to cope with the rapid fading which normally occurs at these frequencies. The fact that this may effect the bass response slightly is of little consequence in what are essentially communication circuits.

While on the subject of response times it may be as well to clarify another characteristic of AVC systems, and one which is frequently confused with the response time. This is the "delay" of the system, most sets using what is called a "delayed" AVC system. The term delay in this case does not apply to time, but to the signal level at which the AVC will begin to operate so that a delayed system is one in which AVC voltage is not generated until the incoming signal reaches a certain strength.

WEAK SIGNALS

There is a very good reason for this because, if it were not so arranged, very weak random signals, such as the general noise level of the atmosphere, would set the AVC in operation, thus limiting the maximum sensitivity of the set. The delay is achieved by biasing the AVC diode plate with a small value of negative voltage so that no rectification takes place until the IF signals exceed this value.

In practice no additional circuitry is necessary to provide this bias. The cathode of the valve is already biased to about three volts in the normal way and, when the AVC load resistor is returned to chassis, this bias appears on the diode plate. As a matter of interest, three volts of IF at this point in the circuit does not

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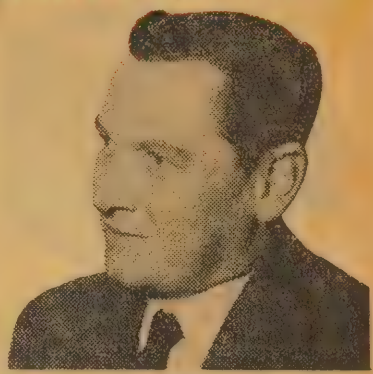

Dear Sir,

I would like to express my thanks and appreciation to you, particularly for the "Learn While You Build" series which was published in your journal.

I had no previous experience in the radio field but have spent many happy hours building the basic crystal set and adding components as each issue of Radio and Hobbies became available. The "Superhet Four" proved to be very good indeed.

My latest effort the "Jubilee Portable" has just been completed and I am more than satisfied with the results obtained. Yours faithfully, K. MARR.

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Working from Crystal Set to Mantel model ensured that not only was the elementary theory made clear, but that the practical side of soldering, neatness and layout became apparent and was learnt.

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Wishing your publication all success, I am Yours faithfully, R. G. THOMAS.

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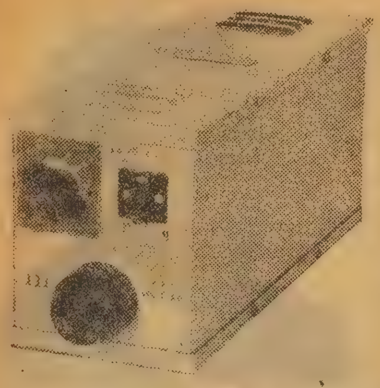

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represent a very strong signal, local stations generally producing anything from 10 to 20 volts.

Which, I think, just about covers the "why" and the "how" of AVC in general, so let us now turn to the job of fitting this feature to the "Superhet Four."

Only a few extra components will be required and the changes involved are not great; just about one evening's pleasant work. At the same time, we felt that to include this feature in the original circuit might well have produced the "last straw" of complexity that broke the camel's—or beginner's—back. By taking it in two bites you have chance to learn what it is all about at the same time as you fit it.

FITTING THE AVC

From the circuit you will see that the two diode plates which were previously linked together are now separated, one being used for detection and the other for AVC. Which is used for which does not matter, but we found the wiring slightly more convenient when the diode on pin No. six was used for AVC.

You will also notice that the original diode load in the detector circuit, a .25 megohm resistor, has been replaced by a .25 megohm potentiometer, while the original 10,000 volume control in the cathode circuit of the ECH35 and the 6AR7 is removed and the cathode resistors returned to chassis.

We were a little worried at first at the prospect of removing this control, since there is very little room between it and the aerial coil. However, the problem more or less solved itself when we realised that we would also have to remove the aerial coil for some minor modification, about which we will have more to say in a moment.

Since the new diode load is now near the front panel and the leads to it considerably lengthened it is advisable to use shielded wire for these extensions, the shielding being earthed to the chassis at a convenient point. To prevent the metal braid from causing short circuits between other components it should be encased in spaghetti or plastic sleeving, a procedure which should always be followed where the wiring is at all crowded.

SHIELDED LEADS

Only two shielded wires are needed to connect the volume control, the third connection being taken to a chassis point near the control.

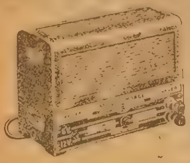
The coupling condenser to the grid of the 6V6 is still located against the rear of the chassis and the free end is connected to the shielded lead from the volume control on a small tag strip (two terminals) secured under one of the IF can mounting bolts. All the remaining connections are short enough to be made with the pigtails of the components involved, these being covered with sleeving where necessary.

The only other major alteration is to the aerial coil. When we described the original circuit we advised readers to use the "Reinartz" coil from previous sets rather than invest in a new aerial coil and this idea worked out quite well. However, because there are not enough pins to accommodate all the connections, the earthed ends of both the primary and secondary windings are taken to

(Continued on Page 71)

SERVICEMAN & AMATEUR'S PAGE

BATTERY CHARGERS



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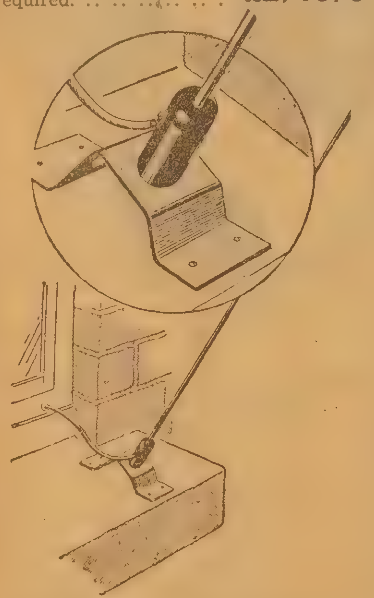

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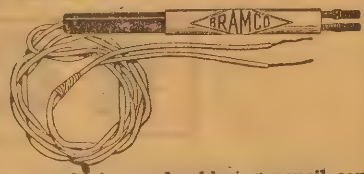

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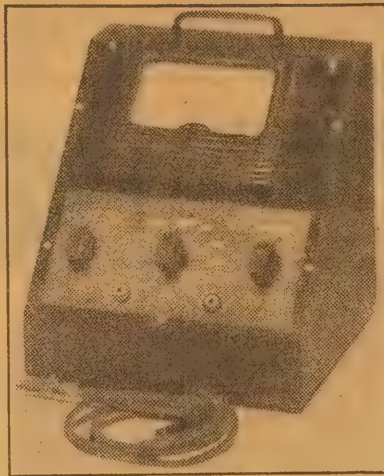
BENCH STYLE METER CASE

A bench style case for the recent "Learn While You Build It" multimeter will probably appeal to many who do not require a portable instrument, and the details given here should enable most people to make their own.

THIS meter was originally designed to fit the same size carrying case as was used for the Standard Multimeter, thus enabling readers to purchase a ready-made case which would be in reasonably good supply.

This latter style of case is useful where the meter is used a great deal in the field and so needs to be portable and well protected. It is not quite so suitable, however, for consistent bench use, neither the horizontal nor vertical placement being particularly convenient ones, and the general tendency is to prop the case against something to provide an angle of approximately 45 degrees.

Working on this basis we decided that a case which would mount the panel at this angle would be very convenient, so we set to with a few scraps of plywood and produced the case shown in the accompanying photograph.



This is how the meter looks when mounted in the finished case, the 45 degree angle being particularly suitable for bench use. The case is finished with leatherette covering as mentioned in the text, but it may be painted or stained if preferred.

DETAILS OF CASE

As it is quite likely that many of our readers will be keen to use a similar type of case we are reproducing a constructional drawing giving all the essential dimensions and, in most cases, it should be possible to work directly from this. However, there are a few constructional points worth mentioning and which may assist those whose woodworking skill is limited.

Best approach appears to be to make the two sides first, the final trimming to size being done by clamping both pieces in a vice and treating as one. The edges may be planed down to the final dimensions, but it is important to plane from either end toward the centre, otherwise the edge of the work is likely to be split as the plane finishes the stroke. If the case is to be subsequently covered there is no objection to temporarily tacking these pieces together to ensure that they remain symmetrical.

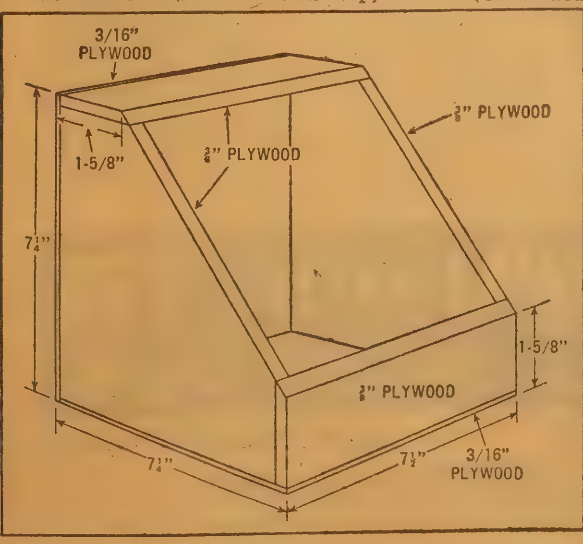
Next make the front and top, which are also two identical pieces. Before planing these to their final dimensions, however, it is desirable to check them gainst the two sides, particularly where the angled edge is to match the 45-degree angle of the sides. In our case the final trimming of this part was done with a fine wood rasp, a procedure which is perfectly satisfactory providing the cutting movement is made along the work rather than across it, to avoid risk of splitting the ply.

PINS AND GLUE

When the trimming appears satisfactory these two pieces may be permanently fitted to the side pieces, using glue and panel pins. We used a cold water glue, which is very satisfactory and convenient for small jobs of this kind and avoids the bother of heated gluepots, &c.

Finally the back and bottom are cut and fitted and the same procedure may be adopted here as for the front and top, namely, to check the final

(Continued on Page 95)



☆

This constructional drawing of the case should provide all the information necessary for the home builder. Joints are made with glue and panel pins and all the dimensions are outside measurements.

The WARBURTON FRANKI Page

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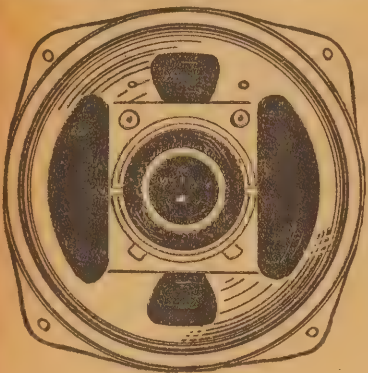

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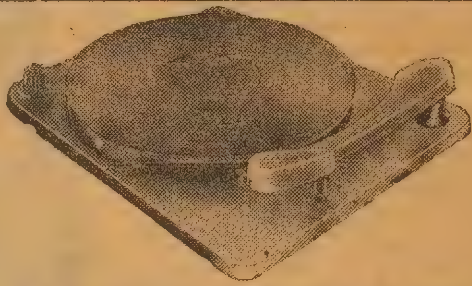

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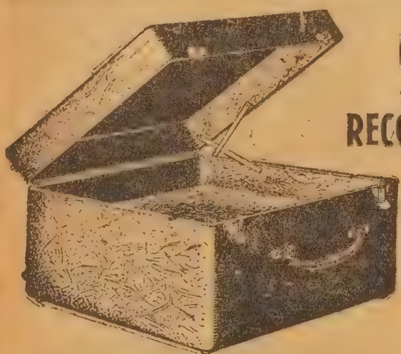

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A COURSE IN TELEVISION

PART 38—INTRODUCTION TO COLOR TV (PART 2)

Having examined the nature of color and its conventional subtractive presentation to the eye, it now remains to examine the alternative process of additive presentation. Since this method is normal to color television, it warrants a fairly close study to avoid possible confusion at a later date.

As we learned last month, objects appear to be colored only because they transmit or reflect to the eye light rays in a particular portion of the visible spectrum. Ideas of color mixing must therefore be based on the mixing of light rays and their net effect on the eye, rather than on the simple physical mixture of pigments and filter systems.

We learned, also, that there are two distinct processes by which color stimulii are produced. One is the conventional subtractive process, as evident in paintings, printed pictures and the majority of colored photographs. The second process is described as "additive" and has yet to be explained.

DEFINITIONS

By way of definition, subtractive mixing is said to take place when a combination of filters or pigments subtracts from the illumining light all but a relatively narrow band of frequencies in the visible spectrum.

When this narrow band of frequencies ultimately reaches the eye, a particular color stimulus is produced.

By varying the density of the pigments or the filters in different areas, a complete color reproduction of a scene may be built up.

The significant point about subtractive mixing is that the eye receives only one band of frequencies from any given area on the picture surface. The merging of the color stimulii may, therefore, be said to occur external to the eye.

By contrast, additive mixing occurs when the eye receives stimulii of two or more distinct colors from sources which exist separately but which cannot be individually resolved.

EXPLANATION

This definition may sound a little involved at first reading but it is readily explained.

By way of example, (1) The colors may be projected simultaneously from different sources onto (or through) a common screen. The separate color stimulii are presented to the eye but mixed therein to produce some predominant color sensation.

Then again (2) the colors may be flashed on to the screen alternatively but in such rapid succession that they are merged by the eye, due to persistence of vision.

Finally (3), the colors may be presented as a mosaic of tiny lines or dots which are too small to be resolved individually. They merge instead into a coherent additive color pattern.

All three methods of additive presentation have been used for color television and, in fact, the additive system is the only one which appears at this stage to be practical.

To employ a subtractive system it would appear necessary to mount between a light source and the eye a series of filters whose density could be varied instantaneously and electronically. No simple method of achieving this result appears to be available, although tentative suggestions have been made.

In the meantime, it is of greater urgency to examine and understand the different color resultants which additive mixing produce.

Perhaps the simplest approach would be to visualise a long tubular box with a ground glass screen at one end and space at the other to insert a number of differently colored light sources. By switching on the light sources individually or in combination, the screen would glow in various hues.

RESULTANTS

By pursuing this technique, it could be demonstrated that red and green light, falling simultaneously on the screen, produce a sensation of yellow.

Similarly green and violet light on the screen together produce cyan, while blue-violet and red produce magenta.

In other words, the colors which are essential primaries to the subtractive system of presentation can be synthesised when an additive system of reproduction is available.

What is more to the point, when an additive system of presentation is available, a scene may be reproduced using the three fundamental primaries in which it was analysed—red, green and blue-violet.

These are the true primary colors and their reference wavelength has been established by international agreement. The figures, as given last month, are:—

ACTUAL FIGURES

700 millimicrons—red but with a slight yellowish tinge.

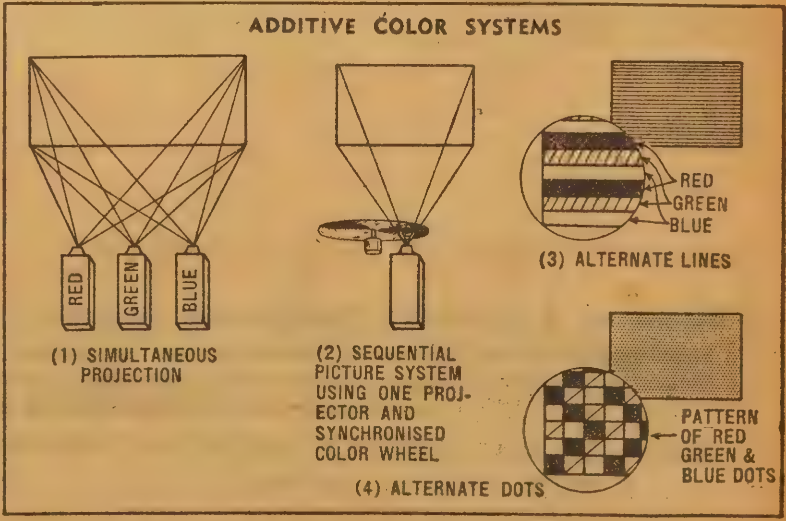
546.1 millimicrons—green, also with a slight yellowish tinge.

435.8 millimicrons—blue with a slight reddish tinge.

While these are standard colors, their practical application sometimes demands some modification, exactly as explained last month in connection with color printing, &c. By and large, however, it would appear that the additive process, using filters and phosphors, involves fewer compromises than conventional pigments and printing techniques.

One of the earliest demonstrations of simultaneous additive color reproduction was demonstrated by Maxwell in England, in 1861.

In that year, Maxwell photographed a scene through blue, green and red filters to produce three separate black and white negatives. These were duly printed on to glass slides and projected in register on to a common screen by three separate projectors, each one through an appropriate colored filter.



Illustrating different methods of additive color presentation.

The nett result was an acceptable three-color image.

In red areas, the only light on the screen was from the "red" projector. Differing proportions of red and green produced tones through the orange to yellow to yellow-green, while green and blue-violet together covered the range through green-blue to cyan.

Blue-violet and red provided the non-spectral purples and magentas, while combinations of all three produced white, shading to grey.

Browns, bottle green, navy blue &c., resulted from low light intensity and/or combinations of all three colors.

TOO COMPLICATED

The principle of simultaneous screen projection has been applied many times and in many ways since Maxwell's original demonstration and is a perfectly legitimate method of color reproduction. Its obvious disadvantage is that it requires three separate films and projectors and the images must be kept in very accurate register.

These considerations virtually prohibit its use commercially, particularly for motion picture work.

The second method of additive color mixing, as mentioned earlier, relies on the persistence of vision.

The classic lecture-room experiment to demonstrate the phenomenon is to fit radial red and green sectors of glass or cellophane to the shaft of an electric fan.

With the sectors moving slowly, both colors are clearly visible. Switch the current on, however, and the two colors appear to merge into a yellow tone.

Equivalent results are obtained from varying combinations of all three primaries, as outlined for simultaneous projection.

This so-called color sequential method of presentation means, in practice, that complete red, green and blue versions of a scene are presented to the eye in rapid succession.

HOW IT WORKS

The images may come from appropriately dyed transparencies. More conventionally, they may come from monochrome images projected through a rapidly rotating and carefully synchronised color wheel. Thus, the version of the scene, originally obtained through a red filter, is projected as a red image because the red segment of the wheel tints the light at the appropriate instant.

Similarly for the green and for the blue versions.

If the rate of presentation is sufficiently rapid, the eye not only fails to perceive the separate images but it successfully merges the primary color images to produce a complete range of secondary color combinations.

Ideally, the rate of presentation should be such that there are from 40 to 60 complete presentations of each color per second, even though this may mean from 120 to 180 pictures per second, all told.

The important point is that, if the repetition rate of each separate color is not kept high, pronounced flicker will be apparent in areas which are illumined by a single bright primary color.

Difficulty also arises from fast-moving objects which are of such a nature that they involve illumination by any two or all three of the primary colors. They tend to break up into separately colored "ghost" images. More will be said of this anon.

PRIMARY, COMPLEMENTARY COLORS

Repeated from last month, this diagram shows the relationship between primary and secondary colors for both additive (left) and subtractive (right) presentation.

The third system of additive presentation involves breaking the scene into tiny segments or lines which are too small or too fine to be resolved individually from the normal viewing distance.

The segments or lines are arranged in ordered sequence and the light reflected or transmitted by them varies according to the content of the image.

Thus, in areas demanding a relatively pure red hue, only the red segments or lines would reflect or transmit light. The other segments would be opaque.

Magenta and purple shades would require transmission by both red and blue-violet segments, yellow would require red and green, while white would require transmission by all three basic colors.

Best known example of additive color is the Dufay system of color photography.

Close examination of a Dufay picture will reveal a three-color segment pattern and, under a microscope or with sufficient enlargement, the three primary colors may readily be observed.

At the normal viewing distance, however, the eye fails to resolve the pattern and the whole merges into a coherent image with the full anticipated range of primary and secondary colors.

Color television systems have been evolved using both the three-color segment pattern and the three-color line pattern. This, in addition to the sequential picture system already mentioned.

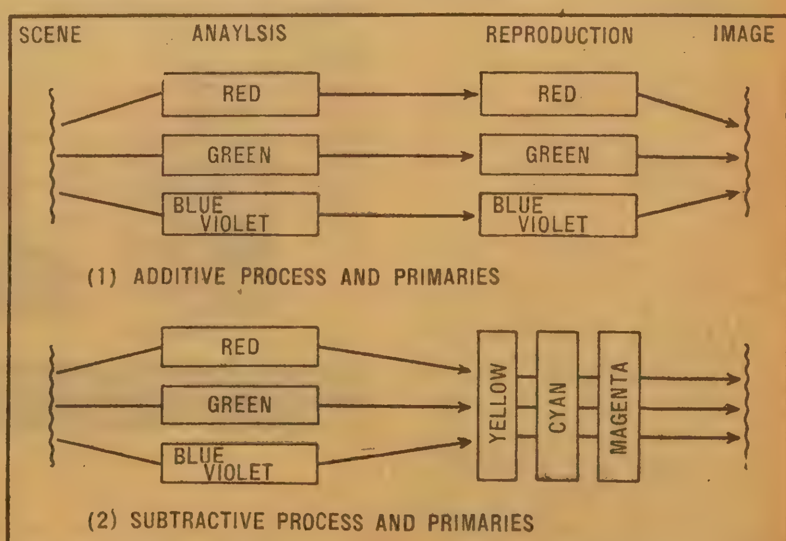
Of all the systems, the segment or "dot sequential" system appears to hold the advantage, for two reasons:—

(1) Color TV signals can be transmitted in such a way that they can be received as normal black-and-white pictures on ordinary receivers. This is of enormous economic advantage.

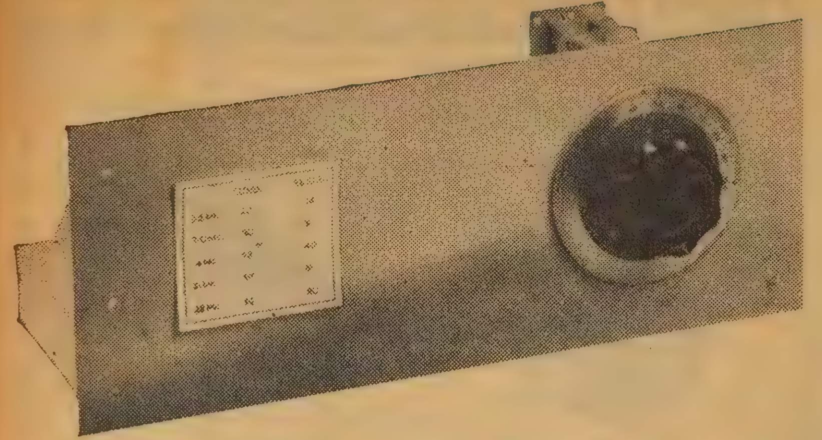
(2) Dot sequential pictures are less prone to flicker effects and to color break-up on fast-moving objects.

Such then is the answer to the several questions which were faced last month . . . What is color anyway? How do colors merge? Why use red, green and blue as primaries? Why not red, yellow and blue?

With all this in the background, we can proceed next month to discuss the actual mechanics of color television—how the various systems actually work.



Illustrating additive and subtractive presentation methods.



Front view of the aerial tuning unit. It is designed especially to match the 5-band transmitter described in the April, May and June issues.

AERIALS FOR YOUR NEW XMITTER

Even more important than transmitter power is the efficiency of its radiating system and, to make the time and care you have put into your transmitter worth while, you must provide it with an efficient aerial. This article contains most of the information you are likely to need and describes an aerial tuning unit for the 5-band transmitter.

by Maurice Findlay

WHILE it is possible to sit down and design a transmitter suitable for a large number of applications, an aerial system must virtually be "custom built." There is little point in our describing one particular aerial with full constructional details, because only a few would be in a position to duplicate it.

In this article, we will give some examples of typical aerial systems, but our main aim is to discuss the principles involved. If you have a knowledge of how aerials operate you will be in the very advantageous position of being able to work out a special aerial system to suit your own particular needs.

AERIAL LITERATURE

Aerial design has been the subject of many lengthy and learned books. Unfortunately, the beginner is often confused by the multiplicity of designs and the endless formulae which have to be studied before he can make a decision as to what type of aerial to erect so that he can get on the air.

There are all sorts of special aerials which will result in improved performance under certain conditions, but there are, fortunately, a number of simple aerials which can be erected in a minimum of time and which will give good results without recourse to slide rules and log. tables.

It is often satisfactory to use a random length of wire for reception, particularly on the broadcast band, but this is not good enough for transmitting, except perhaps under emergency conditions. Transmitting aerials are almost invariably designed to be resonant at the frequency of operation.

A complete explanation of the phenomenon of resonance can be found in one of the standard handbooks and we do not propose to go deeply into the subject here.

Briefly, if a length of wire is suspended in air, away from other conducting objects, radio frequency energy of a particular frequency will excite it more easily than all other frequencies. This frequency is referred to as the resonant frequency of the piece of wire.

The resonant frequency of the wire is mainly dependent on its length. Long pieces of wire resonate at low frequencies, while short pieces of wire resonate at high frequencies. The thickness of the wire does have some slight effect on its resonant frequency, but, unless the thickness is an appreciable fraction of the length, it is not an important factor.

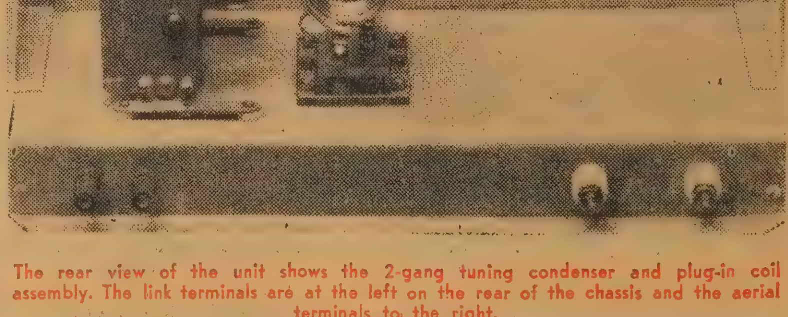
About the simplest satisfactory aerial is, essentially, a piece of wire which is resonant at the frequency of operation.

The length required to be resonant at any particular frequency can be worked out from the formula:—

$$\text{Length of aerial} = \frac{468}{\text{Frequency (Mc.)}} \text{ feet}$$

For example, an aerial to be resonant at 14.1 Mc. would have to be cut to a length of 33ft 2in.

The formula is sufficiently accurate for all practical purposes for frequencies up to 30 Mc. with wire of any diameter you are likely to wish to use. The exact resonant frequency of a particular length also depends on the proximity of other conducting objects, but, again, provided that



The rear view of the unit shows the 2-gang tuning condenser and plug-in coil assembly. The link terminals are at the left on the rear of the chassis and the aerial terminals to the right.

it is reasonably clear of other objects, the formula is sufficiently accurate.

A resonant length of wire strung between two poles high up in the air may be an excellent resonator, but it is of little practical use unless energy from the transmitter can be transferred to it.

But assume, for a moment, that some means has been found of exciting the aerial at its resonant frequency. Possibly this could be done by means of another aerial nearby.

If you had a number of indicators capable of measuring radio frequency current and inserted them at regular intervals along the aerial, you would find that those near the ends would read a low value of current, while those near the centre would read a high value.

If you were to plot a graph marking current on the vertical axis and strength on the horizontal axis, you would obtain a smooth curve, as shown in Fig. 1. A similar procedure with a radio frequency voltmeter would lead to another smooth curve similar to that shown. Note that the voltage is high at the ends and low in the middle.

A convenient place to feed energy into the aerial is the centre, where the voltage is low and the current high. In practice, because the aerial radiates some of the energy which is fed into it, the voltage at the centre of the aerial is never constantly zero. In fact, if a resonant aerial is cut at the centre and power fed into it

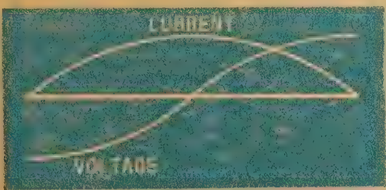


Fig. 1
Current and voltage distribution on a resonant length of wire.

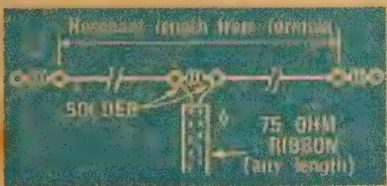


Fig. 2
Simple resonant aerial fed by means of 75 ohm transmission line. If you use a long centre insulator, add its length to the figure obtained from the graphs to obtain the overall length.

Fig. 3
A typical radiation pattern for a simple resonant aerial. The strength scale is calibrated in decibels.

from a radio frequency transmission line it behaves the same as a small-value resistor.

The value depends on its height above the ground and may be between about 55 and 85 ohms. The average is in the vicinity of 75 ohms.

Once having cut the aerial to resonance we can feed it at the centre, adopting the same procedure as would be adopted to feed a 75 ohm resistor.

In special cases the aerial can be connected directly to the transmitter but usually it is better or more convenient to have the aerial situated at some distance. Power can then be transferred from the transmitter to the aerial by means of a suitable transmission line.

TRANSMISSION LINE

A transmission line is an electrical arrangement which enables radio frequency energy to be transferred from one place to another without radiation. It may consist of a pair of parallel wires, sometimes moulded in insulating material, or, where the spacing is fairly wide, supported by spreaders at intervals of a foot or so.

A given length of the transmission line has a certain amount of inductance and at the same time a certain amount of capacitance due to the proximity of the two wires. The ratio of the inductance and the capacitance govern the characteristic impedance of the transmission line. In general, close-spaced transmission lines have low impedance, while wide-spaced lines have high impedance.

Lines which are moulded into a solid insulating medium also have lower impedance than wires which are supported in free air the same distance apart.

If one end of a transmission line is connected to a resistive load equal to its characteristic impedance the other end will present a load of the same value to the transmitter. If the line and the load are correctly matched the exact length of the transmission line is not important.

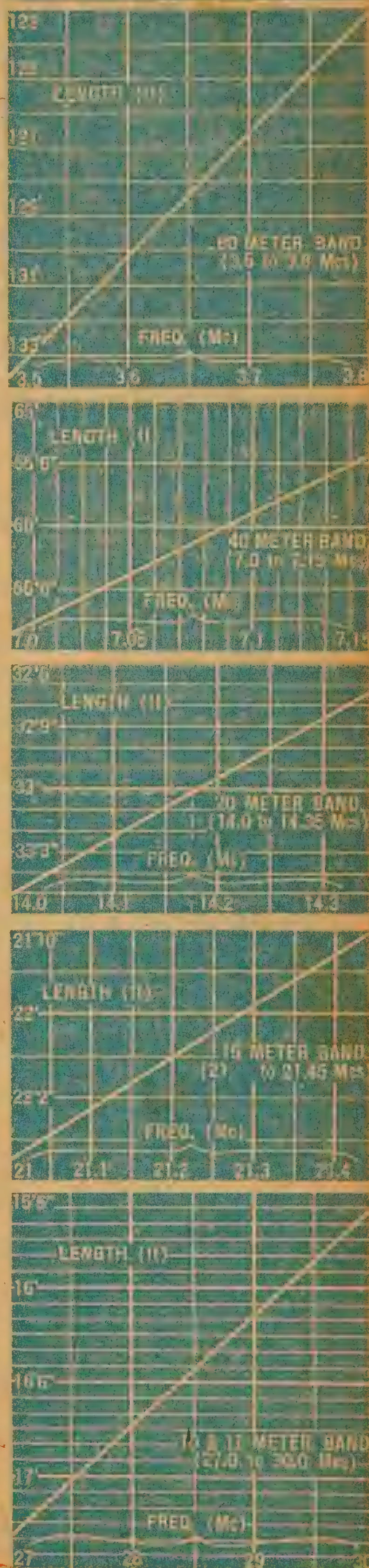
IMPEDANCE VALUES

Transmission lines are available in certain impedances, 75 and 300 ohm being two of the most popular. Manufactured 75 ohm ribbon usually consists of a pair of solid copper conductors spaced about 1-16in and embedded in plastic insulating material. On the other hand, 300 ohm ribbon is usually spaced about 5-16 in.

When the aerial and transmitter are situated remotely they may be conveniently connected by means of a length of transmission line.

If for example you wish to operate on 14.1 Mc cut the aerial to a length of 33ft 2in, broken at the centre with an insulator. Connect one end of a length of 75 ohm transmission line to the aerial as show in Fig. 2. The other end may then be connected to the transmitter or receiver, as the case may be, using any convenient length. The aerial will work at

AERIAL GRAPHS



The length of resonant aerials for the popular amateur bands may be obtained from the above series of graphs. For example, the length required for resonance at 14.175 Mc is just over 33 feet.

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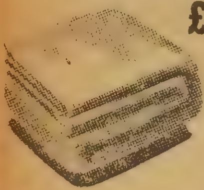

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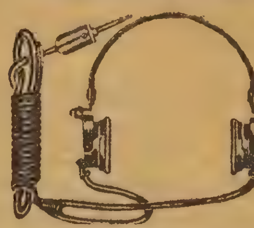

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frequencies as much as .2 Mc either side of the resonant frequency with very little reduction in efficiency.

When the aerial is used for transmitting, power will not be radiated by the feeder line and, conversely, when it is used for receiving the feeder line will not pick up signals. This is often an advantage, because the aerial can be placed clear of a source of interference. Even if the feeder passes through the interference area the receiver will only respond to the signal picked up by the aerial.

While a simple resonant aerial of this type does not have any marked directional characteristics it does tend to radiate a stronger signal in a direction at right angles to its length than it does in the direction of its length. A rough indication of the relative strengths is given in Fig. 3. If you are particularly interested in transmitting in a certain direction it is desirable to erect the aerial at right angles to the line of transmission.

MATTER OF HEIGHT

The strength of the signal received at a distance will depend, too, on the height of the aerial above the ground. Unfortunately, the economics of the situation do not always allow the optimum height to be realised, but it is generally desirable to erect the aerial at least the resonant length above the ground. A 14 Mc aerial therefore could well be mounted about 33ft above the ground. This requirement is less important at lower frequencies.

Many amateurs use separate aerials for each band on which they wish to operate. Separate feeder lines are brought from the centre of each to the operating position and when it is required to change bands the appropriate aerial is connected.

If three or more masts are available there is no great problem in erecting a sufficient number of aerials to cover all normal requirements. Provided they are not too close, the various aerials will not interfere with each other to any appreciable extent.

It is desirable to run the transmission lines for each aerial at right angles to the length of the aerial for as great a distance as possible in order to prevent it from interfering with the radiation pattern. Again, this is usually not a difficult requirement to meet.

NO COMPLICATIONS

Simple resonant aerials of the type we have been discussing have the advantage that they are easy to erect and once cut to resonance require no further adjustment. They are also very easy to connect to the transmitter. In the case of the 5-band transmitter the 75 ohm feeder line may be connected direct to the aerial terminals. The degree of loading is determined by the number of turns on the link coil coupled to the final tank.

Similarly, the aerial may be switched directly to the receiver aerial terminals provided the aerial coil of the receiver is designed for impedances in the order of 75 ohms.

The main disadvantage of this type of aerial is that, except for one special case, it will operate only on one amateur band, making it necessary to use a separate aerial for each amateur band on which you desire to operate.

AERIAL TUNING UNIT DETAILS

COIL WINDING DATA

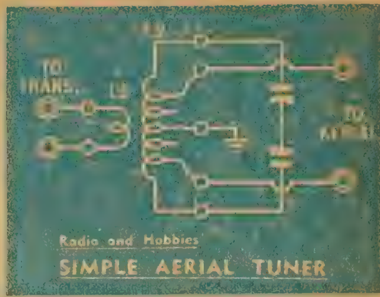
3.5 Mc. L9 34T 20 B & S closewound on 1½in former. Tapped at 4, 8, 12, 16, 18, 20, 22, 26 and 30 turns. L8 from 1 to 4 turns, as required.

7.0 Mc. L9 24T 14 B & S spaced 2in on 1½in former. Tapped at 2, 4, 6, 8, 10, 12, 13, 14, 16, 18, 20 and 22 turns. L8 from 1 to 4 turns, as required.

14.0 Mc. L9 15T 14 B & S paced 1¼in on 1½in diam. former. Tapped at 2, 4, 6, 7, 8, 10 and 12 turns. L8 1 to 3 turns as required.

21.0 Mc. L9 11T 9 B & S spaced ¾in on 1½in former. Tapped at 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 turns. L8 1 or 2 turns, as required.

28.0 Mc L9 9T 9 B & S 1½in diam. spaced 1¾in self supporting. Tapped at 1, 2, 3, 4, 4½, 5, 6, 7 and 8 turns. L8 1 or 2 turns, as required.



However, it is possible to make a single aerial operate on two or more harmonically related frequencies.

Returning to the length of wire mentioned earlier, experience has shown that it is also resonant at twice, three times or any intergral harmonic of the fundamental frequency. The voltage and current distribution of aerials used on the second, third and fourth harmonics is shown in Fig. 4.

CURRENT & VOLTAGE

If you study the diagrams you will notice that two high current and low voltage points occur in the case of second harmonic operation, while there are three such points when the aerial is operated on its third harmonic. A low impedance feeder line can be connected at any of these points.

For special reasons the radiation resistance will not be exactly 75 ohms but it will be sufficiently near this value for 75 ohm cable to be used. For example, a 67ft aerial fed in the centre will operate on 21 Mc as well as 7 Mc. This is a special case and is the only case in the amateur frequency allocations where one band is an odd harmonic of another.

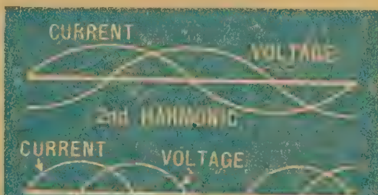


Fig. 4

Current and voltage distribution for aerials operated on the 2nd, 3rd and 4th harmonics. Note the relationship between this diagram and the one on page 53.

Harmonic aerials have a special feature of particular value. It is possible to fold some of the length of the aerial in such a way that it will not radiate. When this is done, part of the aerial actually becomes a special form of transmission line. It can then be brought right to the transmitter without wasting power.

SUITABLE LINES

As you will apreciate, when the aerial is used in this way there will be high voltages developed across certain parts of the transmission line. For this reason close spaced plastic insulated transmission lines do not make particularly efficient tuned feeders. The usual way of making a tuned transmission line is to employ insulated spreaders at intervals of a foot or 1½ feet, the spreaders being arranged to keep the two wires at from 2in. to 4in. apart. They must be sufficiently close to prevent radiation but not so close as to make it difficult to provide adequate insulation at the high voltage points. In the case of the 5-band transmitter, which operates at frequencies up to 30 Mc with reasonably modest power, a 2in. spacing is adequate.

In some cases when the aerial is folded back on itself the high voltage points will appear at the transmitter end so that it is necessary to provide a means of matching the resultant high impedance.

A practical example of the use of tuned feeders will help to clarify the position. To make the discussion even more useful we will take the dimensions which are frequently used in practice.

A 132ft. length of wire is fundamentally resonant in the 3.5 Mc band. However, it will also resonate at the second harmonic in the 7.0 Mc band, the fourth harmonic in the 14 Mc band, the sixth harmonic in the 21 Mc band and the eighth harmonic in the 28 Mc band.

If the aerial is folded as shown in Fig. 6, it can be used on each of the bands mentioned. On 3.5 Mc, the transmitter end of the feeders will be a low voltage, high current point. The part of the aerial which is radiating will not be the full resonant length,

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STANDARD FERGUSON RANGE

For Output Transformers see other ad in this issue.

RECEIVER POWER TRANSFORMERS

CODE No.	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS	RETAIL PRICE
PF185	240	150	30	6.3V/2A	53/9
PF299	240	285	40	6.3V/2A, 5V/2A	53/9
PF300	240	325	40	6.3V/2A, 5V/2A	55/8
PF201	240	225	50	6.3V/2A	54/10
PF151	200, 230, 240	285	60	6.3V/2A, 5V/2A	65/-
PF166	200, 230, 240	325	60	6.3V/2A, 5V/2A	66/1
PF165	200, 230, 240	385	60	6.3V/2A, 5V/2A	71/3
PF170	200, 230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A	78/9
PF169	200, 230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A	80/-
PF168	200, 230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A	74/5
PF130	200, 230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A	84/5
PF164	200, 230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A	84/5
PF160	200, 230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A	93/7
PF152	200, 230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A	104/7
PF163	200, 230, 240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A	106/3
PF181	200, 230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A	116/11
PF174	200, 230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A	109/10
PF142	200, 230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A	118/2
PF175	200, 230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A	136/11
PF173	200,230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A	231/11
PF140	200, 230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A	198/2
PF171	200, 230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A	261/3

POWER AMP. AND LOW POWER TRANSMITTER UNITS

CODE No.	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS	RETAIL PRICE
PF159	220, 240, 260	475	175	6.3V/4A, 6.3V/2A, 5V/3A	231/1
PF172	200, 230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A	261/3
PF143	200, 230, 240	600 500	200	2.5V/5A, 2.5V/5A, 5.5V/.5A	288/9
PF147	200, 230 240, 260	1000 750 500	200 250 300	5.5V/.3A	357/6
PF179	200, 230, 240	475	225	6.3V/CT/4A, 6.3V/2A, 5.5V/3A	225/7
PF107	230, 240	585	250	6.3V/3A, 6.3V/2.5A, 5V/3A	275/-
PF176	200, 230, 240, 260	1250	300	6V/.3A	550/-
PF177	200, 230, 240, 260	1830, 1100	300	6V/.3A	Price on request

VIBRATOR AND AC POWER TRANSFORMERS

CODE No.	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS	RETAIL PRICE
PF182	240AC 12VIB	200	40	12.6V/1A	65/10
PF122	240AC 6VIB	220	40	6.3V/2A	66/1
PF125	240AC 6VIB	250	60	6.3V/2A	77/1
PF126	240AC 12VIB	250	60	12.6VCT/1A	77/1
PF119	240AC 6VIB	325	125	6.3V/4A	109/7
PF146	200, 230, 240 AC, 12V, VIB	325	150	12.6VCT/2.5A	129/5

VIBRATOR TRANSFORMERS

CODE NR	PRIM. VOLTS	DC OUTPUT VOLTS	mA	BUFFER Full Sec.		RETAIL PRICE
VT100	32	200	40	.005		58/-
VT101	6	90	15	.008		45/6
VT102	6	150	25	.005		53/1
VT103	6	200	50	.005		56/-
VT104	6	250	60	.005		57/4
VT105	12	250	60	.005		59/4
VT106	6	300	75	.008		94/8
VT107	6	250	60	.005	Low Radiation	62/8
VT108	12	90	15	.008		47/4
VT109	24	90	15	.008		50/-
VT110	12	150	25	.005		56/-
VT111	24	150	25	.005		61/4
VT112	12	200	50	.005		58/8
VT113	24	200	50	.005		58/8
VT114	12	300	75	.008		102/-
VT115	24	300	75	.008		103/4
VT116	24	250	60	.005		65/4
VT117	12	250	60	.005	Low Radiation	63/4
VT119	32	150	25	.005		53/-
VT121	6	180	30	.005		58/8
VT122	6	400	50	.005		96/-
VT123	12	320	125	.005		92/6
VT124	32	250	60	.005		64/-
VT127	6	200	50	.005	Low Radiation	58/8
VT128	12	250	60	.005	Low Radiation	69/4
VT146	6 or 12	240AC	50W	.05	For emergency light, etc.	86/8

POWER CHOKES

CODE No.	IND. HY.	DC RES	DC mA	RETAIL PRICE
CF100	50	1900	10	38/5
CF101	30	870	25	37/9
CF102	15	300	60	29/4
CF103	30	420	60	55/1
CF104	30	580	75	58/5
CF105	15	250	80	49/1
CF106	12	200	100	50/-
CF107	30	360	100	67/9
CF108	12	135	150	70/5
CF109	20	225	150	73/4
CF110	12	100	200	85/4
CF111	16	165	200	85/4
CF112	10	70	250	85/4
CF113	.5/20	70	250 50	93/6
CF114	1.1	23	375 AC	49/6
CF115	.017	.6	2A	25/9

GRID INPUT TRANSFORMERS

CODE NR	MATCHING FROM	TO	NOM. IMPEDANCE PRIM.	SEC.	MAX. WATTS	RETAIL PRICE
MT104	Mike, P.U.	Grid	3.7, 50	50,000		58/5
MT105	Mike, P.U.	Grid	3.7, 50	60,000		214/5
MT108	Line	Grid	120	1200		129/4
MT109	Cath.	Grid	100	1000		73/4

LINE TRANSFORMERS

CODE NR	MATCHING FROM	TO	NOM. IMPEDANCE PRIM.	SEC.	MAX. WATTS	RETAIL PRICE
MT100	Line	Spkr.	600	4, 3	15	73/4
MT101	Line	Spkr.	500	15	15	73/4
MT124	Line	Spkr.	600 500	4, 3, 2.7 2.3, 2.	25	123/4
MT125	Line	Spkr.	600 500	15, 12.5 8.4, 6.5	25	120/3
MT111	Line	Spkr.	500	12.5, 8 2.3	10	78/10

MODULATION TRANSFORMERS

CODE NR	MATCHING FROM	TO	NOM. IMPEDANCE PRIM.	SEC.	MAX. WATTS	RETAIL PRICE
MT118	Audio Amp	Class C Amp	8000 6000 P.P.	10,000 7000 5000	25	193/4
MT119	Audio Amp	Class C Amp	8000 6600 3800 P.P.	10,000 7500 6500 5500 4500 3500	50	222/10
MT120	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	50	408/-
MT121	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	125	514/8

DRIVER TRANSFORMERS

CODE NR	MATCHING FROM	TO	NOM. IMPEDANCE PRIM.	SEC.	MAX. WATTS	RETAIL PRICE
MT106	Class A Driver S.E.	Class AB1 Grids	5000 Step Up 1:5 Pri. DC 40 mA	125,000	5	127/9
MT107	Class A Driver HI. MU. S.E.	Class A Grids P.P. or S.E.	10,000 Step Up 1:3	90,000	1	186/5
MT112	Class A Driver HI. MU S.E.	Class A Grid P.P. or S.E.	10,000 Step Up 1:2 5 mA DC unbalance	40,000	.5	117/4
MT113	Class A Driver S.E.	Class AB2 Grids	5000 Step Down 1.25:1 40 mA Pri. Dc	3200	2	139/6
MT114	Class A Driver P.P.	Class B Grids	5000 Step Down 1, 1.5 or 2	5000. 2200 1250	5	159/9
MT115	Class A Driver P.P. or S.E.	Class B Grids	5000 Step Down 1.07 or 1.4 40mA DC max unb.	4400 2500	5	159/9

FILAMENT TRANSFORMERS

CODE No.	PRIM. VOLTS	SEC. VOLTS	RETAIL PRICE
PF117	240	2.5V/.3A.	38/-
PF118	220, 240, 260	2.5V/5A, 2.5V/5A.	66/5
PF158	220, 240, 260	5V/8A.	73/4
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A.	104/-
PF162	240	6.3V/3A, 6.3V/3A.	76/5
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A, 5V/3A, 2.5V/7A.	220/-
PF102	240	7.5V/2A.	55/9
PF111	240	10V/5A.	78/10
PF131	230, 240	10VCT/10A, 5V/15A.	234/8

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but the system will still be quite a reasonable radiator.

Study Fig. 4 and Fig. 5a in conjunction and you will observe how we determine whether voltage or current feed should be used.

LINK COUPLING

In the cases where a low voltage high current point appears at the transmitting end the aerial may be coupled to the transmitter by means of a link in much the same way as the low impedance feeder line. When a high voltage point occurs at the transmitter end the number of turns required to obtain adequate coupling would be impractical. The feeders could be coupled directly to the final tank circuit, but this has the disadvantage that it tends to encourage the radiation of harmonics.

An excellent scheme, because besides discriminating against harmonics it allows a convenient means of matching and loading, is to provide a second tuned circuit similar to the tank circuit and link coupled to it. The aerial may then be coupled to this second tuned circuit.

If means are provided for varying the coupling between the final tank circuit and the aerial tuned circuit and taps are provided on the aerial tuned circuit it is a simple matter to match either a high or a low impedance load and at the same time provide the correct degree of loading for the transmitter. The extra tuned circuit and its associated components constitute what is known as an aerial tuning unit.

With the various requirements in mind, we constructed the aerial tuning unit shown in the photographs to match the five-band transmitter and its associated modulator. The panel is 15½in x 6in, and the chassis 14in x 6in x 1½in. There is plenty of room for the components of the basic unit, and also some additional components we intend to mention next month.

AERIAL TUNER

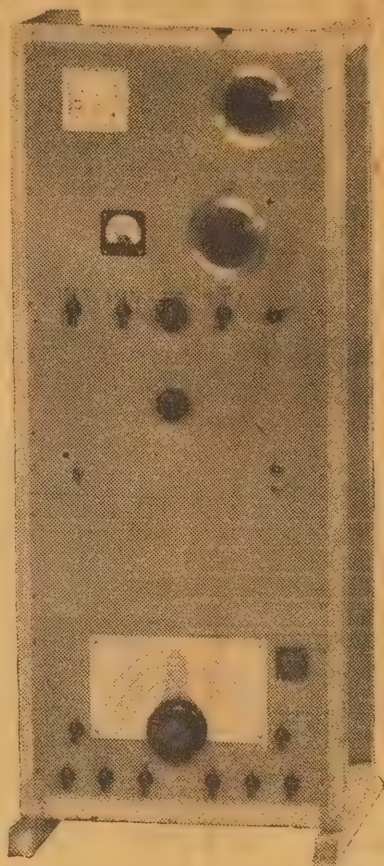
As you will note from the photographs, the tuning condenser is mounted on the right-hand side of the unit, looking from the front. The control knob is balanced by a scale showing the control settings.

Looking at the unit from the rear, the tuning condenser is on the left and the coil to the right of the condenser, just sufficient clearance being allowed to prevent the condenser plates interfering with the coil. On the rear of the chassis, the terminals connecting with the link are at the left and the aerial terminals at the right.

Most of the work in making the unit goes into the coils, five of which are required to cover the five amateur bands between 3.5 and 28 Mc. The construction is generally similar to the final tank coils except that seven instead of five-pin bases are required, and the winding job is made somewhat more difficult by the need for taps.

The coil formers are all 1½in diam. and 2¼in long. They are mounted on 2¾in x 1¼in x 3/16in polystyrene bases by means of long bolts. The seven banana plugs required for each coil are mounted in two rows ½in apart. By the way, it is very desirable to include a pair of small diameter fibre washers when mounting

COMPLETE TRANSMITTER



The complete transmitter and a receiver may be mounted in a rack only 3ft 3in high. Further details of the rack will be given next month.

each banana plug. Not only does this help to spread the pressure on the polystyrene, but it prevents it melting when heat is applied for soldering.

The coil socket is made from a piece of polystyrene 3in x 2in x 3-16in thick, being drilled to correspond with the coil base. It is a good plan to mount the individual sockets in the polystyrene in such a way that they can move slightly in a sideways direction to allow for inevitable discrepancies in the pin positioning of the various coils.

COIL DETAILS

Full details of the coil taps are given in the coil table, but the link windings require individual adjustment. Coupling between the final tank and aerial coils can be varied by varying the number of turns on the link windings. This adjustment may be effected at either or both ends.

If a change from one integral number of turns to the next does not give a sufficiently fine adjustment, use the greater number of turns but wind the coils of somewhat larger diameter than the tuned coil. This will give looser coupling than with the link wound tightly over the tuned coil. A still finer adjustment can be obtained by twisting the link coil in relation to the other coil.

There should be no difficulty in obtaining a sufficiently fine adjustment on the 3.5 and 7.0 Mc bands, but 14 and 21 Mc may require some careful treatment. The 28 Mc coil is self-supporting, so that the link may be pushed in and out of the coil to give a continuously variable adjustment.

In its simple form the aerial tuning unit may be used to couple the transmitter to practically any aerial, provided the aerial and feeders add up to a resonant length. Later we will

(Continued on Page 93)

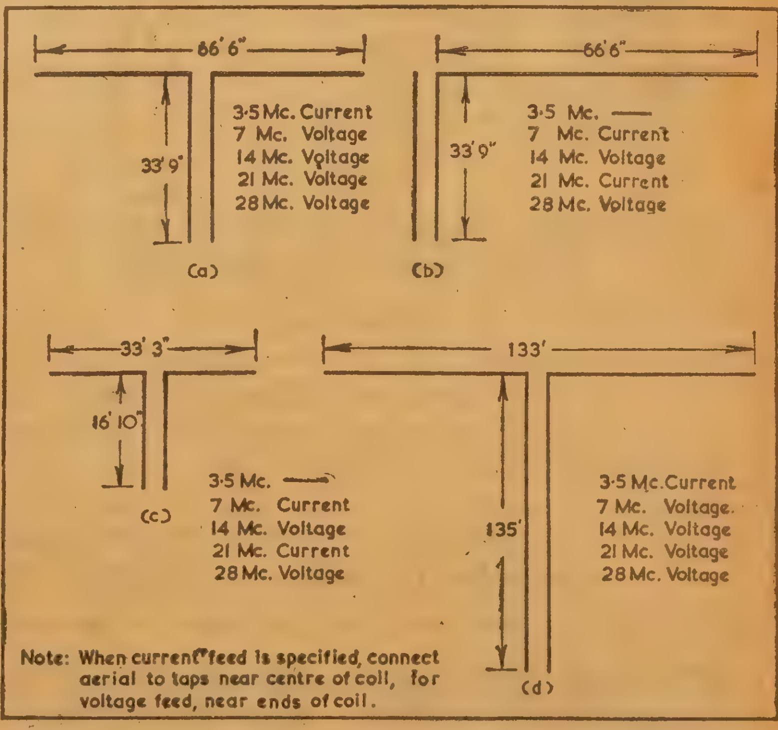


Fig. 5. Four typical multi-band aerials for amateur bands. In general, centre feed is to be preferred to end feed because of the better balance obtainable, and, hence, lower radiation from the feeders.

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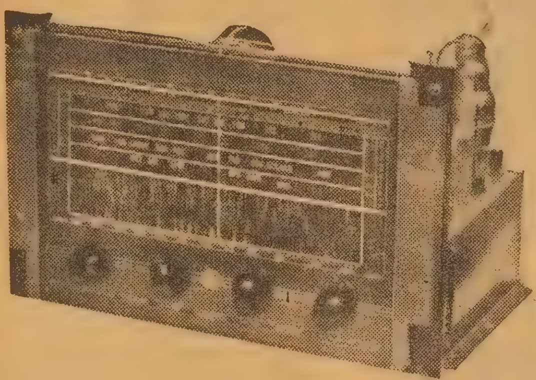

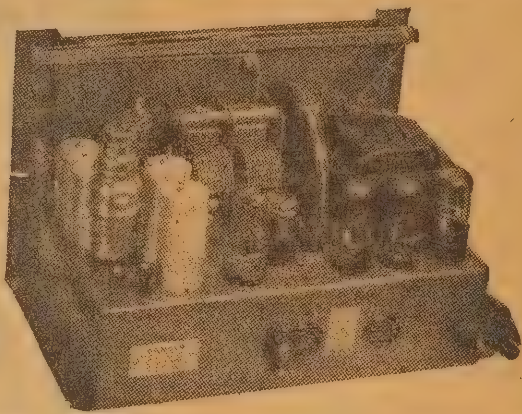

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FROM THE SERVICEMAN WHO TELLS

Maintaining a polite front to customers who frequently assume that they know far more than the serviceman is a strenuous business, so I trust that readers will understand and pardon me if I let off a little steam in print. I also have some remarks to make about pinch-penny tactics in set design.

I SUPPOSE it is only natural for people to attempt their own diagnosis of a faulty set, even if it amounts to no more than a wild guess hurled at the serviceman when the chassis is pushed over the counter. Many such efforts are more amusing than helpful, while some are downright fantastic.

One of the most frequent types is the one who "thinks it's a valve" while following a close second is the one who "doesn't think it's a valve" or, as a slight variation, "think it's only a little thing." Of course, you may imagine that these statements are based on mere guesswork or intuition, but not a bit of it. They are the result of the most careful observation, by the owner, of all the circumstances prevailing at the time of the failure.

CUSTOMER TYPES

Thus the type who "think it's a valve" will base his assumption on any one of four possible symptoms: (a) that the set failed after it had been playing for some time, (b) that it failed when first switched on, (c) that it has failed completely or (d) that it is only a partial failure.

Likewise, the type who is convinced it is not a valve bases his diagnosis on four possible symptoms which, strangely enough, are identical with those cited by the "thinks it is a valve" bloke, a state of affairs which, I must confess, I find rather confusing.

Then there is the rather garrulous type who goes into minute detail about the program to which he was listening when the set failed, thus: ". . . and the kids were listening to Superman, see, and Superman had just stopped the express train with one hand when the set gave a funny crackling sound, like something loose inside y' know, and then wouldn't go any more."

VALVE OBSESSION

Frankly, I can hardly blame it and I can only assume, on the evidence which the owner has placed before me, that the set just couldn't stand it any longer. But if you imagine that this type is a variation on the others you're likely to be disillusioned for, as like as not, he will conclude his remarks with the statement. "Mind you, I don't think it's a valve."

The underlying theme behind all this is that the valve is allegedly the least reliable and most expensive part of a set and that the failure of this component is the most disastrous thing that can happen. Even the customer who hasn't a clue to the trouble — and knows it — will usually express the hope that, "it isn't a valve" though, presumably, he would regard a broken down first electrolytic, with resultant burnt out rectifier and power transformer, as a mere minor defect.

So great is this valve obsession that the worth of a receiver is invariably judged on the number of valves it "uses" or "wears out" over a number of years, so that it is quite usual for an owner to boast, "You know, this has been a marvellous set, I've had it over five years now and never had to replace a valve." At the same time he will conveniently forget any other repairs it has required, since these, presumably, don't "count" in the same way as a valve.

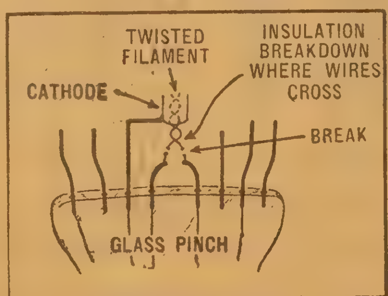
THE CAUSE

And what brought all this on?

Well, as you may have guessed, it was a recent experience with a customer who insisted that the fault in his set was a defective valve. He had no convincing proof of this condition, at least none that would convince me, but he was quite insistent that such was the case simply because the set was completely dead.

He was also rather worried about the prospect of missing his favorite evening serial and expressed a desire, as he passed the set over the counter, to have the job done as quickly as possible. I agreed to at least give it a once over immediately and to let him have it back before nightfall if the repairs did not call for a major operation.

It was a four-valve mantel set and as a test also indicated a complete absence of life from either the converter grid or the IF amplifier grid, I decided the valves had better be tested (just in case) before removing the chassis from the cabinet.



A weak point in valve construction seems to be the point where the filament commences to twist before entering the cathode sleeve. An insulation breakdown at this point shorts out the major portion of the filament and overloads the remainder.

However, as I removed the valve shields I realised that I would have to look no further, for the fault was staring me in the face. What was more to the point was the fact that it was a valve, for the filament of the 6G8 was quite dead.

A closer examination, by holding it to the light, was all that w[as] necessary to confirm my suspicio[n] for the break was clearly evide[nt] just where the filament entered t[he] cathode sleeve. As a matter of fa[ct] it is not the first time I have e[n]countered this fault and the sto[ry] behind it seems to be a rather i[n]teresting one.

As far as I can make out t[he] initial fault is one of insulati[on] breakdown which occurs just whe[re] the two sides of the filament lo[op] make their first twist before ente[r]ing the cathode. When this happe[ns] the major portion of the filament [is] shorted out and the two short lengt[hs] between the breakdown and the su[p]porting wires are subject to the fu[ll] filament voltage. Naturally th[ey] can't take this for many seconds a[nd] a complete burn out is the result.

Doubtless this is just another [of] the manufacturing problems whi[ch] plague the valve engineers and [we] can only be thankful that it is rel[a]tively rare.

On the more practical side a[n]other problem had arisen. I did[n't] have a replacement for that pa[r]ticular valve and there was not mu[ch] chance of obtaining one in time [to] keep my promise to the customer. [I] did have a 6B8, and I considered t[he] possibility of using this as a te[m]porary replacement, but it is not [a] direct replacement and there w[as] some doubt as to whether it wou[ld] be entirely satisfactory.

POSSIBLE DISTORTION

The main difference is that whe[n] as the 6G8 is a variable-mu ty[pe] the 6B8, although similar in m[ost] other respects, is not intended [for] use with variable bias and, whe[n] large values of AVC are applied, [as] from a local station, it is likely [to] distort severely. Nevertheless, I d[e]cided to try it and was agreeab[ly] surprised to find that it perform[ed] quite well. Even with an outdo[or] aerial and a strong local station the[re] was no serious distortion and it loo[k]ed as though the customer wou[ld] have his set on time after all.

As to why it worked so well I c[an] only guess, since I had no oppo[r]tunity to check the circuit, but t[he] most likely suggestion is that t[he] screen of this valve was fed throu[gh] a series resistor. When this is do[ne] the plate current cut-off point is e[x]tended considerably due to the r[ise] in screen voltage as the bias is i[n]creased, the decrease in screen cu[r]rent with increased bias serving [to] bring this about.

On the other hand, a screen vo[lt]age which is held essentially co[n]stant, as when supplied from a vo[lt]age divided tap, will cause the pla[te] current to cut off more or less [as] predicted by the valve manufa[c]turers and, with the 6B8, this ha[p]pens at a fairly low grid voltage.

Anyway, whatever the cause, t[he]

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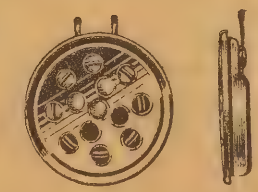

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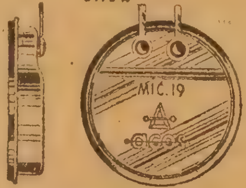

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set was quite useable and the owner was very happy when he called in to collect it. I explained the temporary replacement and that I would have the correct valve in a few days, an arrangement to which he readily agreed, adding, as he tucked the set under his arm, "You know, I thought it was a valve."

Another case I had this month also started with a valve inquiry. The first approach was simply to have the valve tested (it was a 6J8 converter) and when this showed a normal emission the owner expressed some surprise. It seemed that his set would not receive any stations lower in frequency than 2GB and someone had told him that such a state of affairs was due to a faulty converter valve.

OTHER CAUSES

I agreed that this could be so and, in fact, often was, but I also pointed out that it was not the only possible cause of such troubles. When any set (that is, a superhet) refuses to work on part of the band it is a fairly safe bet that the oscillator is dropping out of oscillation and this generally happens first at the lower frequencies due to the poorer coupling which they provide.

There are many things which can cause this trouble, such as a weak valve, reduced HT voltage, or a partial failure of almost any of the components in the oscillator circuit. I explained all these points and then suggested that, as it did not appear to be the valve, it might be better to bring the chassis in for a check.

But our friend wasn't having any. As far as he was concerned the trouble was in the valve, my test and comments notwithstanding, and he was going to fix the thing himself. (He didn't say this in so many words of course, but it was fairly obvious that it was what he was thinking.) Anyway, he insisted on purchasing a new 6J8 and I decided to let things take their course.

Next day he was back, this time with the chassis, and rather sheepishly admitted that the new valve had not cured the trouble. On test it appeared to work more or less normally at the higher frequencies but there were no signals on the low side of 2GB. However, there was the usual noise level, and this is a normal symptom of oscillator failure, the set still receiving signals but only at the intermediate frequency.

OBVIOUS FAULT

Once again I did not get further than a visual check before the fault became apparent, this time in the form of several small ball bearings adhering to the chassis by their own grease. They had, of course, come out of the gang condenser, resulting in a partial mis-alignment of the fixed and moving plates.

There were still enough left in place to provide some kind of a bearing surface and the movement of the gang appeared, at first glance, to be quite normal. However, there was just sufficient mis-alignment to allow the oscillator section of the gang to short over the low frequency portion of its travel.

Fortunately none of the ball bearings was missing and I was able to effect repairs by simply slackening the rear bearing and replacing them with a pair of tweezers. This is not a really difficult job, but it does call for a measure of patience and it is often easier to remove the gang from the chassis so that it may be mounted in a convenient position. It was so in this case, the front of the gang being rather crowded when it was on the chassis.

With them all back in place in the front bearing it was then only a matter of correct adjustment of the rear bearing to ensure that the plates were correctly aligned and also that there was no chance of a recurrence of the trouble, after which the gang was fitted back on the chassis, the set checked and finally re-aligned.

As I said, there are plenty of things other than a valve which can cause a set to fail over part of the band.

And finally I have a case which looked like being a sticky one at one stage of the game. It was a rather elaborate radiogram, though not a very well-known make, and the owner complained that it gave forth a loud buzzing noise. Some careful inquiries disclosed that it had never been satisfactory and had been returned to the makers twice as well as being checked by two other servicemen, none of whom seemed able to track down the elusive buzz.

FAULTY SPEAKER?

Naturally such a build-up was hardly encouraging but, on the other hand, it made me determined to get to the bottom of the mystery—if only for my own satisfaction.

The most likely explanation seemed to be that the speaker had developed a rattle which only showed up occasionally on certain notes, but the owner was very vague on this point, as owners frequently are. Nevertheless, I made sure that the speaker was delivered with the chassis and set the whole lot up on the bench where it could operate undisturbed while I proceeded with routine jobs.

My first impression was that the reproduction was quite normal so I simply let the set run in the hope that the offending "buzz" woul show up sooner or later. After few hours of this with no sign trouble I realised that it was not go ing to be all plain sailing. I ha tried every kind of musical numbe from an organ to an operatic hig C and it had handled all of the without a murmur.

It was when I began making more careful check, by placing m ear close to the speaker, that realised that there was a certa amount of hum in the output. wasn't enough to be heard witho a baffle but it could be quite readi felt with the fingers. Could this b the buzz of which the owner wa complaining and which had elude previous investigators? It seeme silly, but I realised that they, lik myself, could have been looking f an entirely different fault, simp because of an error in terminology

DOUBLE CHECK

However, I was determined make sure of the point. I mount the speaker in a spare cabinet a checked it again. It certainly was merry hum and might have be described as a buzz by anyone n too sure of the usual terminology

As a final check I contacted t owner, took him into the worksho and asked him if that was the bu of which he complained. It seem that it was and he was most anixo to know if I thought I could do an thing about it. I told him I thoug I could, now that the exact natu of his complaint had been establis ed, and pointed out, as tactfully I could, that the probable reason wh he had not obtained satisfaction far was due to some confusion ov this point. He did not seem partic larly worried, appearing to be main interested in the fact that the troub was going to be fixed at last.

Of course, I imagined that the j would entail no more than the r placement of a couple of electr lytics at most, and blithely set to

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find out if it was one or both. The filter arrangement was quite conventional, consisting of two 8 mfd electrolytics and the usual filter choke. First I tried a new electro across the first one, which reduced the hum a little but not enough to indicate a fault, so I concluded it must be the second one. When I obtained much the same results here I began to wonder if it was going to be as easy as I thought.

COMPLETE CHECK

I double checked on the electrolytics by completely disconnecting the existing ones and fitting a pair I knew to be good, but there was no improvement. I checked the rectifier, both for general efficiency and to make sure both halves were operating, and also the power transformer in case one side had gone open circuit, but all seemed correct.

I was finally forced to the conclusion that the choke, a midget type tucked away in the rear corner of the chassis, was just not adequate for the job and that the fault was, therefore, essentially one of design. To prove the point I temporarily replaced it with one of more reasonable dimensions, whereupon the hum vanished.

But it was one thing to replace the choke temporarily and quite another to make a permanent job of it, for the layout of the chassis and the available space was just not suitable. After trying various methods to accommodate the larger choke I finally came to the conclusion that it could not be done, at least without a major re-build which would have been far too costly, and that some higher values of capacitance might be a more satisfactory solution.

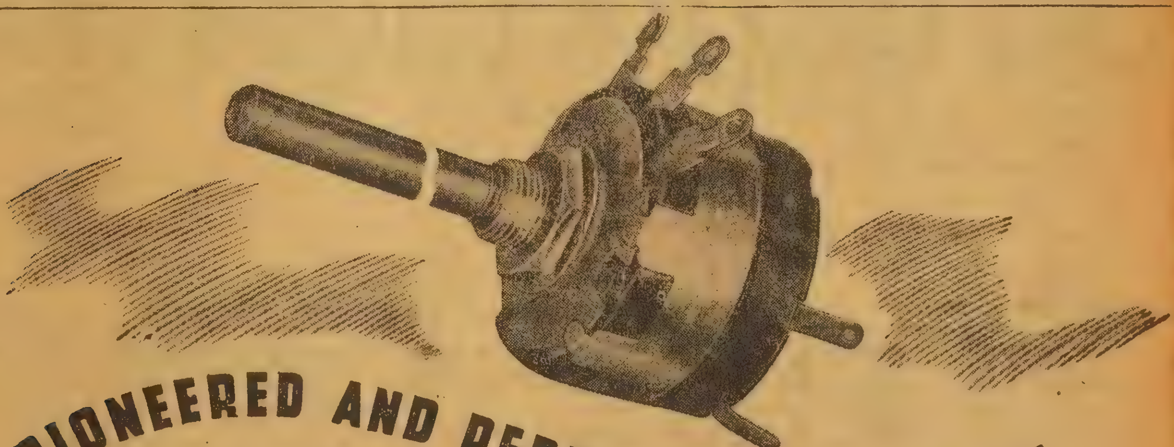
Accordingly I set to with a handful of 16 mfd condensers and found that two of these in parallel with each of the existing electrolytics was sufficient to reduce the hum to negligible proportions. In spite of the apparent clumsiness of such a brute force arrangement I decided that it was justified in the circumstances and, after all, did produce the desired result at a reasonable cost.

FALSE ECONOMY

As far as the design of the set was concerned I could only give it my unqualified condemnation and nominate the design engineer — or his principals who insisted on such pinch-penny tactics—for the bobby prize in set design. By no stretch of the imagination could such a policy be justified, for the extra cost of a decent choke would only amount to a few shillings and was negligible compared with the fancy price asked for the set.

Yet it had caused one customer considerable inconvenience and expense and had doubtless cost the goodwill of a great many others, all of whom probably echo the sentiments of my customer who was most emphatic that none of his friends would purchase such a set if he knew anything about it.

All of which adds up to a type of publicity which can be fatal.



Let's Buy An Argument

Just as I had anticipated, the remarks in May issue about hearing aids brought to light a good deal of comment. The excerpts from various letters are completely typical in that they emphasise the two extreme points of view—the academic "thou shalt not" and the humble plea to "give it a go."

by **W. N. Williams**

THE reader from Waverley, NSW, makes special reference to carbon ·ype aids, apparently to emphasise ıst how simple some hearing aids ın really be. I think I could quite ıfely add the words, "and useless" › the above sentence, although some ıay care to join issue on this point. ime will tell.

Reason for making such a stateıent is that I was recently asked › look over such a device that had ıce belonged to a distant and deeased relative. Apparently he had ained a certain amount of assistıce therefrom, although notoriously ırd of hearing.

The device consisted of two paralıl-connected carbon microphones in case which served the dual purpose looking very professional and proding some kind of a sound-reflectıg surface. Inside each mic. were veral dozen round carbon balls and carbon cup of extremely traditional ıttern.

A single and (I must confess) very nsitive headphone clamped to the ead with a band, while a couple of cells provided the necessary power for the circuit.

Oh yes, there was some kind of switched resistor in circuit labelled euphemistically "loud" and "soft," as well as "off."

The "off" position was the only one which the batteries could possibly have accepted with equanimity, because the measured drain ran up to something around 200 milliamps.

But did it work? Well, it did seem to make things just a little louder. My guess would be around the 6 to 8 db mark. As for the quality, it used an elementary carbon microphone and nothing more need be said.

It may well have been a poor example of its kind but the whole idea certainly did not stir me to any feelings of enthusiasm, even on the grounds of sheer simplicity. Still, I could be wrong!

Then there is the reference to a circuit by John Bristoe published in a wartime issue (March, 1945). It used a 6J7-G, an EL3-NG, a 5Y3-G and a receiver-type power transformer.

By present standards, the choice of such components would be ludicrous, but those were days when you couldn't buy standard items for new equipment, let alone specialised midget components. Nevertheless, to judge by references to the circuit, some folk were able to knock together from "junk" useful amplifiers of a similar nature.

NOT SATISFIED

Nowadays, we could at least do a lot better than that.

From Brisbane, our correspondent E.L. really got himself worked up, making it necessary, for reasons of prudence, to quote his letter in part rather than in full.

He puts a point of view, which I have heard many times before — namely that a great many purchasers of hearing aids are dissatisfied with the results they obtain.

Doubtless there are charlatans in the hearing aid business, as in any other. One technician I know recently inspected a most imposing "Hearing Analysis" panel to find that most of the knobs and switches were not connected to anything at all.

Against that, I have personally inspected equipment which made possible a most exhaustive analysis of a person's hearing, including frequency response, threshold of perception, threshold of pain, perception of differences in sound level and so on.

There was even a concealed, silent operating key, which enabled the operator to know whether the patient was really hearing the signal or just imagining he could.

You remember the old trick of the school doctor and the stopwatch.

No, E.L., I can't possibly agree that all hearing aid specialists are racketeers.

I do know, however, that there are many psychological and practical complications which can lead to erroneous conclusions on the part of the patient. Some of these I have already mentioned:

(1) Lack of familiarity with the partly-forgotten world of sound,

which leads the wearer to conclude that the hearing aid is a manufacturer of noise.

(2) The lack of binaural perception, which eliminates the automatic selection of what we wish to hear.

(3) The frequent complication of limited dynamic range in the hearing, which causes pain on loud sounds when enough gain is used to hear the weaker ones.

(4) Improperly adjusted frequency response which gives all sounds an unfamiliar thin or "woolly" quality.

(5) The sheer cost of batteries and maintenance.

WHAT IS NEEDED

The answer to points 1, 2 and 3 necessitates understanding and a deliberate psychological adjustment on the part of the patient. Unless this need is adequately met, no hearing aid in the world will be accepted. The "victims" just go on grumbling that the makers are crooks and don't know the first thing about the business.

By way of comparison, there are plenty of folk who are forced to use separate "distance" and reading glasses, or who spend several days stumbling around while they get used to bi-focals.

It's doubtless a confounded nuisance but there's just no way out of it when the muscular accomodation of the eye is lacking. And it's not much use, either, branding opticians as incompetent, because of it. You just have to admit that the eyes are not as good as they used to be and get used to the "winkers."

Point No. 4, about frequency response, is one of the factors that needs to be assessed and designed for while (5) the cost of batteries is self-evident. That's why I talked earlier of possible AC operation for "evenings-at-home" use.

How many of us would wear spectacles if they cost us so much a week to run?

In saying all this, I'm not plugging for the hearing aid people nor picking on E.L. The point of note is that complaints about "unfair treatment" may stem from a variety of sources.

There may be some point in the further suggestion about using two earphones and a volume control between them. I should imagine that it would depend largely on whether the remaining ear were good enough, on its own, to give some degree of binaural perception, even if only on loud sounds.

BINAURAL AIDS

However, it is elementary that, for true binaural hearing, two separate microphones, amplifiers and earphones would be necessary.

Several correspondents have indeed agreed that binaural facilities would be very welcome but it is not clear whether they know this from experience or just think they would be.

I have never had occasion to study the subject sufficiently to know what tests have been made along this line and economics aside, what benefits accrue and to what overall proportion of patients.

But there's an obvious interest in the whole matter.

Then, there's the letter from H.B., who is clearly apprehensive about putting into the hands of unskilled or unscrupulous persons the know-how of building hearing aids.

MUCH ADO ABOUT HEARING AIDS

LONG OVERDUE

I have read every copy of "Radio and Hobbies" and "Wireless Weekly." I can't understand why neither of those journals has ever had an article on how to make a hearing aid.

I made one myself in the nineties with carbons, pointed and set in a carbon with 6 holes bored in it, and used an old telephone receiver I bought for 2/-.

In those days we made our own batteries, mine was Hydrochloric-Bichromate (I haven't seen one for years). Old "Wireless Weekly" described three amplifiers and "Radio and Hobbies" an article by a writer named Briscoe. All these were mains AC. I made two and expected Mr. Briscoe's article to be followed by a battery operated aid. I have seen about 100 letters answered in "Wireless Weekly" and "Radio and Hobbies" for requests for a hearing aid.

I, myself, wrote "Would it be possible to use 1K5 valves" as described a few years ago in "1K5-FOUR" and "Inter-com 1K5." The blackouts were so severe that I found the AC sets useless. The reply I got was:—"We do not feel inclined to set to and work out such a set. Why not use an AC?" You know I am afraid to say anything that might offend a journalist. They can reply in print.—(M.C.P. Waverley, NSW.)

IT'S A RACKET!

Being deaf myself, and the owner of two hearing aids, my experience may be an aid in your endeavour to create a hearing aid that would be a blessing to other people.

But I would like to transgress and say that most firms who sell deaf aids, do so on the understanding that it is a racket.

For instance, I bought a model for £49/10/- but it developed an intermittent fault. They charged me £2/15/- to "repair" it but it still played up. I took it back, and again was charged £2/4/9 for "a new condenser." I finally went through the works myself, and found the fault which was a dry solder joint.

I recently bought a second set from another firm, but I got much the same treatment. They sell you their "Latest Model," and in a few months time they tell you that the aid you bought is of no more use to you, as your hearing has "gone back" etc., and want you to buy another "Latest Model."

Hundreds of deaf people will not buy these hearing aids from firms because they fix the aid so that it is almost useless to the owner. "an invention of the devil" as you say on page 73, and the owner (buyer) is pestered to buy a "better set" even after only three months.

It has always puzzled me why "Radio and Hobbies" is so slow to design a simple deaf aid unit. I have often been on the point of writing on the matter, but have always thought that nobody would care.

In my opinion, a deaf aid should have bass boost, treble boost, AVC and binaural phones. Without AVC a hearing aid is useless.

When a person buys a hearing aid, he is supplied with one moulded earpiece (they grab extra for that, too). But I had one made for each ear, so that I could exercise each ear, instead of only one. I asked for, and was willing to pay for "Binaural" earphones, or ear inserts, but was told that the power would not be enough (45V).

In your article on page 73, you state "a binaural table model with two microphones and amplifier, coupled to separate headphones." Would two microphones and amplifiers be necessary?

Some people are deafer in one ear than the other ear, so why not have the volume control between the two phones?

Also wanted in a hearing aid is a means to cut out background noises. The hearing aid used for hearing speech, should start to operate just below 110 cycles, thereby eliminating the unwanted noises of lower frequencies. When the hearing aid is being used to hear music a means should be incorporated in the aid to fetch in those lower musical ranges for music and to be cut off for hearing speech.

Now if you will create a hearing aid containing these features, and give it birth in "Radio and Hobbies" you will find that hundreds of them will be made, and will be used. Too many buyers of commercial hearing aids are only owners, but not users, and the commercial firms know that to be true, through their non-battery sales.—(E. L. Brisbane, Q'ld.)

WANTS TWO PHONES

I'm all for the designing of a binaural deaf aid, and would like to offer one or two suggestions. First, the two microphones should be arranged directionally so that the point of greatest pick-up of one is 180 degrees from that of the other. The idea of having the device electrically operated is sound, for the sake of economy, but would not be very convenient for still active people who are deaf.

A battery operated model could be designed that would be about half the size of a personal portable receiver, without resorting to the use of sub-miniature parts.

The conventional type of deaf aid would be much improved, in my view, by being fitted with two earphones. The idea of supplying a person who is deaf in both ears with one earphone is in the same category as supplying an individual with defective vision a "pair" of spectacles having only one eyepiece. Fitting the amplifier with two microphones "aimed" in opposite directions might effect a further improvement. Or would it?—(R. L. K. Mungungo, Q'ld.)

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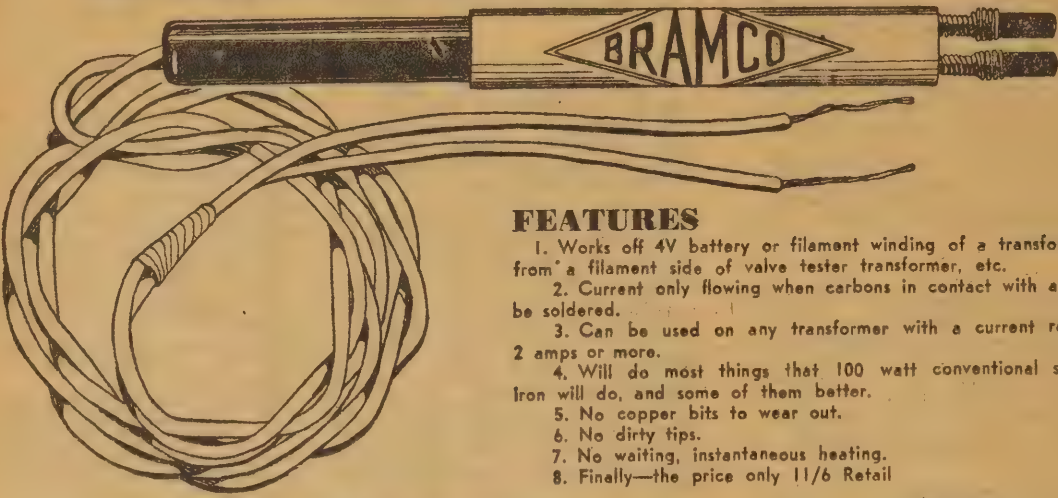

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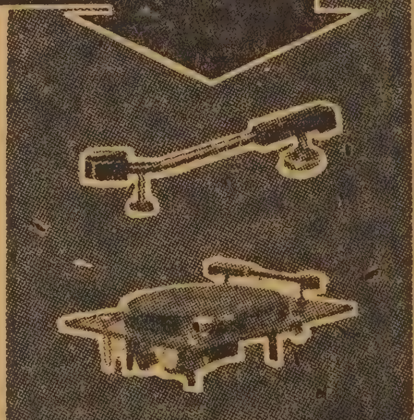

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Is designed for the connoisseur who likes these fine technical developments that produce faithful reproduction. The heavy non-ferrous turntable is machined to run dead true, the flywheel action eliminating all "Wow."

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Is in the true tradition of Connoisseur sound reproducing instruments. Distortion at 5w is less than 0.5 per cent. Bass control variable from 3 to plus 15 db. at 50C.S. Treble control variable from minus 20 to plus 8 db. at 15kcs.

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COLOR PROBLEMS

As one who has studied and used color film in a somewhat large proportion, I find that your article has borne out to a large degree, the theory of color and its constituents.

You have hit the nail on the head when you say that the dyes used are a compromise. However, this use of compromised color has resulted in a definite line of thought as to what constitutes "WHITE" light.

Science has proved that pure (and I mean PURE) pigments of red, blue and green when mixed in equal proportions, will result in a final white, which to the eye is White.

The cyan, magenta and yellow dyes in the subtractive principles of color are the complementary colors in the negative and when these negatives are reprinted to form the positive they revert to the original colors of red, blue and green, as seen by the camera in the original scene.

From my interpretation of color television, I am led to believe that the scene is scanned in the principle of the additive process. This would mean that the final picture would be reproduced as a positive in the same colors. However, if the system used the subtractive method of scanning, it would need an electrical inverter scheme to transfer the resultant image to a positive for viewing.

Color is not color but is reflected light. In other words we see what is reflected after other colors have been absorbed by the object being viewed.

If we view a scene through a colored glass or filter we cause that scene to be transformed in color value by holding back certain light dependent on the make of the filter.

There is one question I would like to ask here; You, as a movie viewing person, have no doubt seen both English and American Technicolor films and have no doubt noticed the difference in the color result on the screen. The English version is soft and pleasant to the eye and the American film is of brilliant, almost harsh, treatment of color. These films are all made by Eastman-Kodak and Technicolor Limited and yet vary in rendition. WHY?—(H. D. D. Albert Park, Vic.)

filters whose opacity could be controlled electrically.

I talked to Phil Watson about possible differences between American and British technicolor films. Phil (who knows about these things) doesn't think there is any fundamental technical difference between them, or at least enough to get upset about.

In his opinion, the difference in result on the screen has more to do with the artistic approach of the producers. The Englishman (ever conservative, by gad!) tends to record scenes and costumes as they normally are in everyday life.

The American, on the other hand, having paid out for his color film, "just ain't gonna waste the gol-darned stuff." He has no inhibitions about costumes and sets either, as you might have noticed.

Maybe this is a deplorable libel but Phil Watson said it . . . I didn't.

One little point on color before I pass on. H.W.McQ. sends this conundrum comment on my own conundrum:

"You ask, can colors possibly exist anywhere else but in the hidden recesses of the human mind?

"Do you doubt it? If so, try to extract any single color from the feathers of a brightly colored bird."

There is certainly something to be said along this line but it may equally well be contended that anyone who has ideas of launching into the production of numerous doubtful aids won't be discouraged by the lack of a Radio and Hobbies circuit.

On the other hand, there is some reason to believe that individual constructors might well be enabled to knock something together fairly cheaply, once the general principles and design factors are appreciated.

No, H.B., I'm not against home-made hearing aids, as you have apparently inferred from the previous article. The whole point was to air a few of the known difficulties and to ferret out other reactions and ideas from folk who knew the problems of deafness at first hand.

On the subject of color, H.D.D. appears to see eye to eye with me on most matters. However, after reading paragraphs 4 and 5 of his letter, I am left with the suspicion that he is trying to classify methods of scene analysis into subtractive and additive systems. If so, this impression is completely wrong.

The terms subtractive and additive apply only to the method of presentation to the eye and the original scene is always analysed in terms of red, green and blue-violet.

It is true, of course, that the complementary filters are used in some processes for taking, but this does not make the process into a subtractive one. It merely offers a method whereby one photographic step can be avoided. What is a negative through a fundamental filter becomes a positive through its complementary.

By the same token, there can be no such thing as "subtractive scanning" in television. You might conceivably use complementary filters and an electrical inversion process but that would be purely a variation in method.

As I said in the last article, a subtractive method of presentation for television would require a system of

Achievement

Here is a complete set of parts from which you can easily build and operate your own radio receiver and learn the function of various components and the fundamentals of radio receiver assembly.

Entertainment

There will be lots of fun in building up this Marconi set and then you will have your very own radio to listen to your favorite programmes. No soldering is necessary — a screw driver is all you require, and no additional listener's licence is needed.

Satisfaction

The components are first grade, the valve is one of the latest miniature types and the complete set will surprise you with its range and power.

The "Marconi" Kit is available from radio retailers and department stores. Get yours today.

YOUR OWN SIGNALLING CIRCUIT

With a few scrap parts plus some ingenuity you can make a signalling system to rival the local post office. Not only will the system described here give you means of communicating with your mates but it will give you an excellent, and almost painless method of learning the Morse Code.

MANY boys have a friend living next door with whom they would like to communicate, whether just for the fun of it, or perhaps, to discuss the night's homework. Such a system need not cost more than a few shillings, and if you go about it in the right way it can be a good way of learning the Morse code.

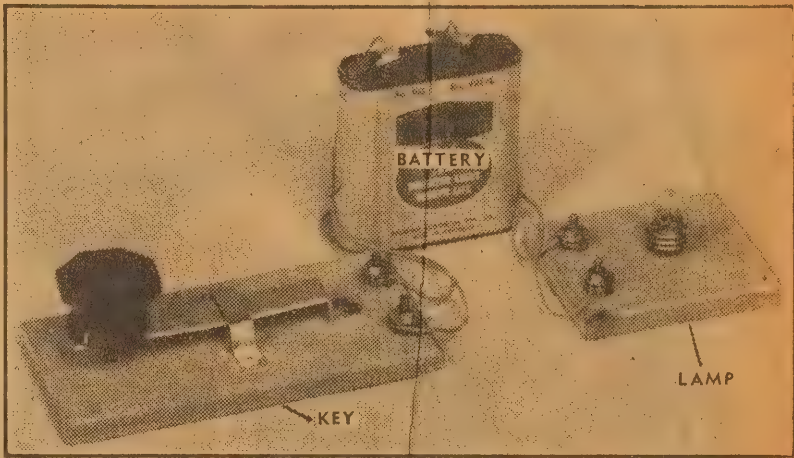
A working knowledge of the Morse code and other signalling systems is always an advantage. One of the PMG requirements before an applicant can be issued with an amateur wireless station operator's certificate is that he has passed an examination in sending and receiving at a prescribed speed. Many organisations, including Boy Scouts, teach the code.

WHAT YOU NEED

The essentials of the system we describe here, are a key for opening and closing the circuit, a buzzer and a battery to supply the electric current.

A simple buzzer for the signalling system was described in the January issue and if you wish to send messages in two directions you will need two of them. The best plan is to combine forces with your friend and share the work. Full details of the construction as well as a detailed explanation of how the buzzer operates are given in the January issue, and provided you are willing to take a little care, you should be able to make a completely successful buzzer. It will take a little more time than other parts of the system.

The key shown in the photographs was made from some very ordinary materials which happened to be lying around the workshop. The baseboard is a piece of plywood 2½in x 5in, and the lever was bent to shape from a piece of 18 gauge scrap metal 4in long and ½in wide.



The key and lamp holder are both constructed on ⅜in plywood. Other materials you will need are, scraps of 16 or 18 gauge metal, 16 or 14 gauge tinned copper wire, ⅛in nuts, bolts and washers and a torch lamp. The battery required depends on the lamp or buzzer.

Two terminal posts, each made up of 1-8in bolts, nuts and washers are mounted on the end of the key and connected, one to the metal strip and the other to 1-8in bolt mounted directly under the knob, by means of lengths of copper wire. The wire may be bare, tinned or enamelled, but, in the latter case, it will be necessary to remove the insulating enamel so that a good contact can be made.

A small saddle, also made from sheet metal, is placed over the arm of the key and adjusted by bending so that the knob moves about 1-32in or less. The amount of tension in the key can be adjusted before the saddle is mounted in place.

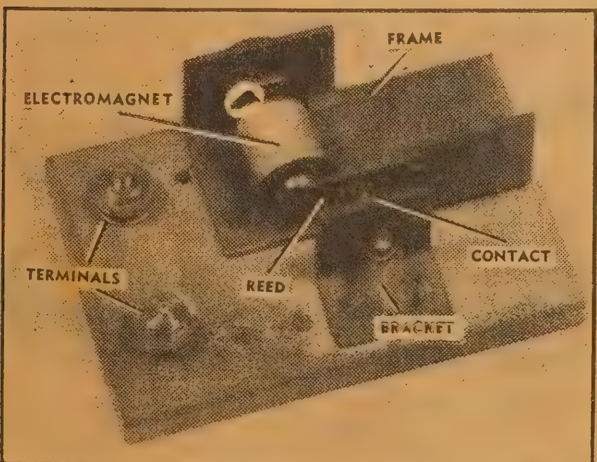
While it is not possible to make a key with all the facilities of the better class commercially-made keys an excellent job can be made with scrap materials, provided due care is taken. If you can manage to obtain a good commercial key, possibly from one of the military disposals stores so much the better. In the past, it has been possible to obtain them for a few shillings.

SIGNALLING LAMP

Sometimes, it is desirable to use a lamp as the indicating device instead of a buzzer. A low current lamp may be used in cases where the resistance of the line is so high that a buzzer cannot be made to operate efficiently. It also has the advantage that, as no sound is created, it will not tend to disturb other people nearby.

To protect the lamp, and enable it to be connected in and out of circuit easily, we mounted it on a piece of plywood as shown in the photograph. The holder is made by twisting a length of thick copper wire around the base of the lamp so that it forms a corresponding thread. After bending the end of the wire away from the thread portion, it is twisted under the head of a bolt which goes through the wooden block. The second contact with the lamp is made via a second bolt, which also goes through the wooden block. The two bolts are connected to a pair of terminals in the same style as adopted for the key.

A key, a battery, and either a lamp or buzzer may be connected in series to make up a practice set. The complete set will do almost the same



☆

Full details of the buzzer were given in the January issue. Scrap parts may be used but the construction must be rigid if it is to operate reliably.

☆

MORSE CODE SOUNDS

The Alphabet

A di dah
B dah di di dit
C dah di dah dit
D dah di dit
E dit
F di di dah dit
G dah dah dit
H di di di dit
I di dit
J di dah dah dah
K dah di dah
L di dah di dit
M dah dah
N dah dit
O dah dah dah
P di dah dah dit
Q dah dah di dah
R di dah dit
S di di dit
T dah
U di di dah
V di di di dah
W di dah dah
X dah di di dah
Y dah di dah dah
Z dah dah di dit

Figures

1 di dah dah dah dah
2 di di dah dah dah
3 di di di dah dah
4 di di di di dah
5 di di di di dit
6 dah di di di dit
7 dah dah di di dit
8 dah dah dah di dit
9 dah dah dah dah dit
10 dah dah dah dah dah

Other Signs

Period: di dah di dah di dah
Comma: dah dah di di dah dah
Question mark: di di dah dah di dit
End of message: di dah di dah dit

job as one of the complete commercial sets, the cost of which may be pounds.

However, if you have a mate living nearby, you will want to have two sets and arrange them so that you can communicate with each other. The diagram we have prepared shows how two sets may be connected by means of a single line. We are assuming that an efficient earth return can be made to a water-pipe. If not, you can use a pair of wires.

In most cases, there will be no difficulty in making good earth connections at either end. A water-pipe generally makes an excellent earth and connection can be made to it by wrapping a length of wire around the pipe, or a neat clamp can be made from a piece of scrap metal.

INSULATED WIRE

The line between the two stations must be insulated from earth. If rubber or plastic covered wire is used, no other precautions will be necessary but the insulation on ordinary enamelled wire is not good enough to stand up to exposure to weather for any length of time. If you use enamelled or bare wire it will be necessary to support it on insulators every so many feet. The insulators may be the regular porcelain type but insulators made from pieces of scrap bakelite or ebonite will be just as efficient for this purpose.

The permissable length of the line depends mainly on the thickness of the wire. If the distance to be covered is comparatively short you can use thin wire but thick wire will improve the efficiency, especially if your friend's house is situated at a distance.

Some compensation for line length can be made by using a battery of a higher voltage but in the case of the simple circuit shown this has the disadvantage that the buzzer, or lamp, as the case may be, at your own station will be subjected to a greater stress than the remote buzzer or lamp.

You could compromise by, say, using a 4.5 volt battery with a buzzer which will work on 3 volts. When you are transmitting, your own buzzer would have a reserve of operating power while your mate's buzzer would have a little less, depending on the length of the line.

VOLTAGE

For long line lengths, the lamp may have some advantages since it can usually be made to operate with a lower voltage applied than the buzzer. By the way, it is desirable to have the facility of hearing your own sending.

It is actually possible to connect three or more stations together, so that any one station may transmit to the others. The limitations to the system are the battery which must deliver additional current for each station and the connecting wires which must carry the extra current. Of course, you could arrange the inter-station wires so that it is possible to switch to the one desired station or stations, if the system is a large one.

Volumes have been written on the subject of learning the morse code but the essential points can be covered in a few paragraphs.

First of all, morse is essentially a sound language. If you make the mistake of learning it as a series of dots and dashes you will have to mentally translate each character into sound before you can send it. Time will be saved if you learn the code as a sound language in the first place. For this reason we have not published the usual series of dots and dashes but rather a series of dits and dahs which can be read as the sound.

If you read off the symbols just as they are printed you should be able to get very close to the correct rhythm but if you can get an experienced operator to go through the code with you a few times you will find it very easy to get the correct rhythm.

LEARN RHYTHM

From then on it is simply a matter of memorising. Learn the 26 letters first and then you will find the figures fairly easy. Other special symbols can be picked up fairly easily as you go along.

Experience rules against learning the code by a system of opposites or similarities. The danger here is that you will have difficulty in deciding between F and L or B and V when you start sending and receiving. You should be able to recognise each letter on its own merits without the need to go through a process of thinking out its relation with other letters.

You can use otherwise unprofitable time for memorising the code. If you travel to school in a bus, tram or train, try reading the advertisements in code to yourself. After, at the very most, a week of this, you should know every letter with certainty and be in a position to send and receive correct and legible messages, even if only at a fairly low speed.

Sending and receiving with the lamp requires a different technique and must be learned separately. It is not possible to send and receive at as high a rate with the light method as with sound but, as Boy Scouts will know, there are many situations where visual communication is possible and sound communication not possible. A knowledge of both methods is of great value and the simple communication system we have described will help you greatly.

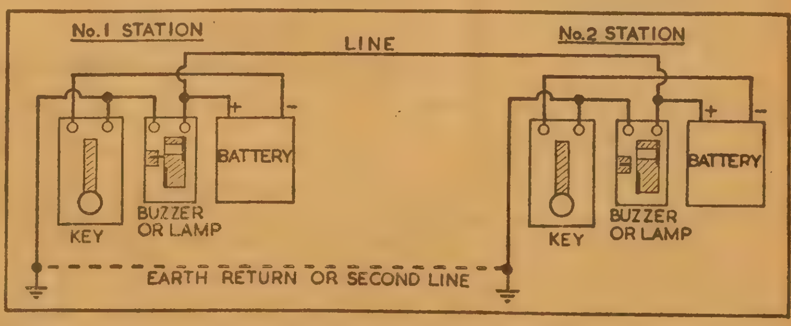
NEW SERIES

Our aim over the past few months has been to provide a series of articles to cover a few of the important topics of elementary electrical work from the practical point of view.

The "Junior Experimenter" who has followed the series will, without the need for abstract study, have gained a valuable working knowledge of electrical principles.

Next month we intended to begin a series of articles treating radio in a similar way. If you have followed the electrical articles all to the good but if not, the new series will be so constructed that you will be able to understand it even if you know nothing about radio or electricity.

There will be something new to build each month, but we will see to it that the cost of the parts is down to a minimum. Any parts you buy will be able to be used several times over in different sets.



Messages may be sent in either direction if the connecting wires are arranged as shown above. Additional stations may be added simply by making connection to the line. In all cases the power comes from the sending station.

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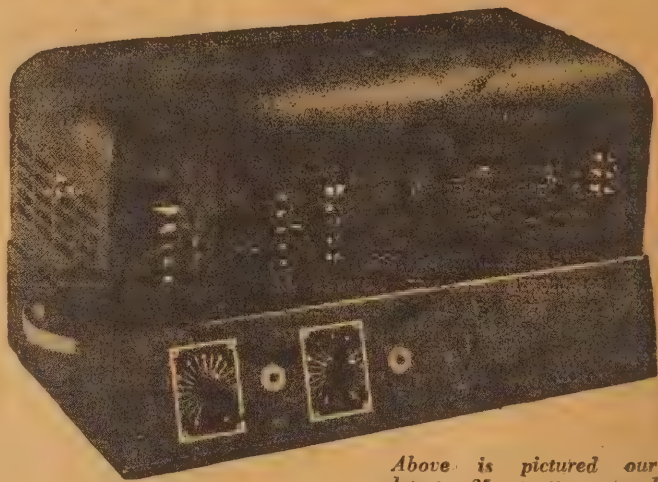
Whether you are a hi-fidelity enthusiast, or a public address man, you will find an amplifier to suit your purpose in the latest Electronic Parts range. High quality amplifiers which you can obtain ready built or in kit form, at Commonsense prices.



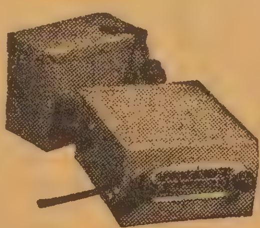
Above is pictured our latest 25 watt general purpose amplifier. At left is an illustration of the general appearance of amplifiers ranging from 5 watts upward.

'R & H' PLAYMASTER AMPLIFIERS AND CONTROL UNITS

The complete range of Radio & Hobbies Playmaster amplifiers control units, and tuners is detailed in our latest amplifier catalogue. This splendid series offers high quality sound reproduction to suit all tastes. Send coupon, write or call for our latest Amplifier Catalogue and Price List.

SEND FOR ***FREE*** CATALOGUE.

RADIO KIT-SETS



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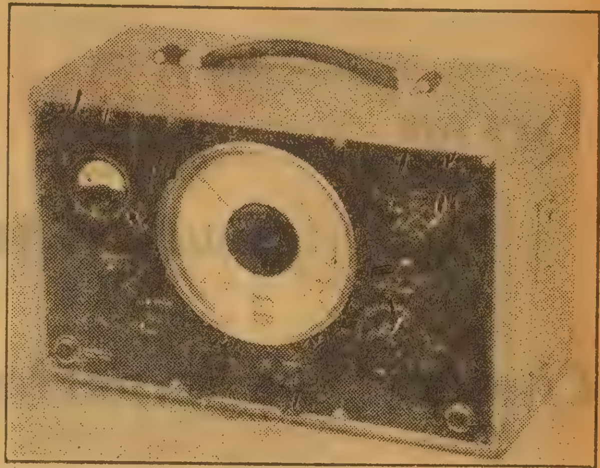
KIT-SET SPECIALISTS

TRADE REVIEWS AND RELEASES

PHILIPS RELEASE RF SIGNAL GENERATORS

The latest addition to the Philips range of test instruments is a signal generator and a test oscillator which are intended to fulfill the RF generating requirements of both the laboratory and the service shop.



ILLUSTRATED on the right is type GM2883, which is the more elaborate of the two instruments, and is intended mainly for laboratory use. It covers from 100 Kc to 30 Mc continuously in five bands and features an open scale spread over approximately 270 degrees.

A special feature is a sixth band which also occupies the full sweep of the dial but covers only from 400 to 500 Kc, the resultant frequency spread being designed to facilitate the taking of selectivity curves of IF amplifiers.

Internal modulation is set at approximately 30 pc, and is available at two frequencies; 400 cps or 2500 cps. Modulation is not applied to the oscillator valve, but to a buffer stage which prevents the application of modulation or the setting of the attenuator from affecting the RF oscillator. External modulation may also be applied, the low frequency oscillator valve acting in this case as a straight audio amplifying valve, the range of frequency being from 30 to 10,000 cps.

The type GM-2884 is a service oscillator of a simpler design more in keeping with the requirements of the service shop or routine production testing department.

It covers from 100 Kc to 25 Mc in six bands and is fitted with a 400 cps internal generator which modulates the carrier to approximately 30 pc. This audio not is also available at the output terminals by operating a panel switch, and has its own intensity control.

Both units are designed for AC operation, and may be adjusted for a large number of supply voltages from 110 to 245, and at frequencies from 40 to 100 cps.

NEW CONVERTER

AMALGAMATED Wireless Valve Co., Pty., Ltd., announce the release of a new Australian-made novel Radiotron—the 6AE8.

This nine-pin miniature, now available from stock, is intended for use as a frequency converter in all-wave and broadcast superheterodyne receivers.

The miniature equivalent of the older octal based X61M, the 6AE8 has improved characteristics giving superior performance. Under typical operating conditions, this high gain valve has a conversion conductance of 750 micromhos and a plate resistance of 1.5 megohms.

The 6AE8 also features improved short-wave performance, lower interelectrode capitances and better frequency stability, making it a useful companion to the 6BE6 converter.

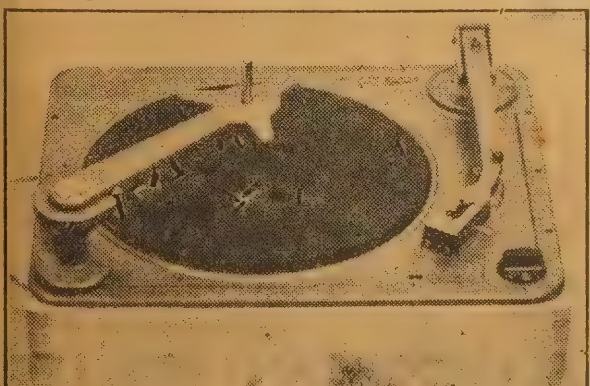
3-SPEED CHANGER FROM FALK & CO.

Fred A. Falk & Co. have submitted for review a record changer, designed for use with either standard or microgroove recordings, and marketed in Australia under the trade mark "Dual."

ONE of the most valuable features of the unit is its ability to play both 10in and 12in records, intermixed, without the need for any adjustment to the changer mechanism, compensation being made automatically as each record is selected.

The general workmanship throughout appears to be of a very high order, and we were particularly impressed with the smooth operation of the changer and the quiet, rumble-free, turntable. The latter is mainly due to a unique drive system between the motor and the turntable rim, allowing the three speeds, 78, 45 and 33 1-3 rpm to be selected in a precise and positive manner by means of a knob located near the pickup head.

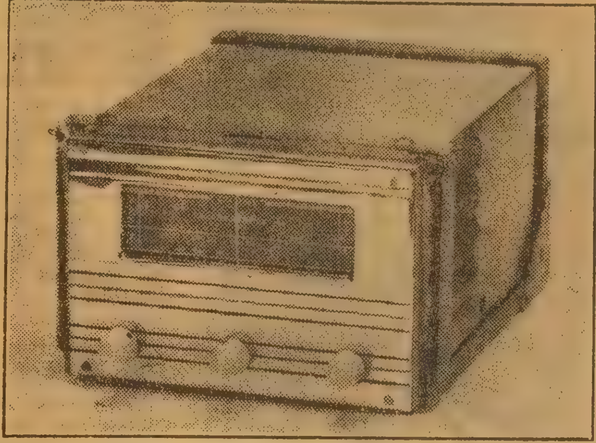
The pickup is a crystal type, which employs a toggle head to allow selection of the correct sapphire point for either microgroove or standard records. The weight has been adjusted to a compromise value, which the makers claim is perfectly satisfactory for both types of record.



The output is sufficiently high to permit direct connection to most radio receivers and simple amplifiers, the natural rise in response at the bass end making compensating circuits unnecessary for this purpose. The over-all response curve of the pickup appears to follow very closely the normal characteristic which applies to most crystal pickups.

SLADE'S CAR AND HOME RADIO

Latest release from Slade's Radio Pty. Ltd. is a car radio which, in addition to being an excellent performer in this role, has the added feature of being suitable for use as a domestic set operating from the AC mains.



THIS feature is a particularly valuable one as, in the normal way, a car radio is often not given enough use to justify its initial cost, whereas the need for a second set in the home is often very real. A set which can perform both functions should, therefore, appeal to a large number of potential purchasers of car radios.

The method of making the change-over is quite ingenious. When used in the car the set is held in a light but substantial tray which is supplied with the set and becomes a permanent attachment to the car. The receiver is held by a single knurled screw on the underside of the tray while all necessary power connections are made automatically when the receiver is fitted into place.

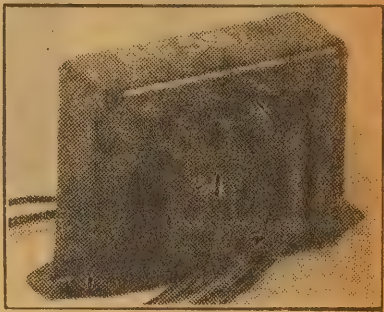
When it is desired to operate the set from the mains it is only necessary to disconnnect the aerial, slacken off the knurled retaining screw and withraw the set from the tray. A correctly wired socket fitted to a standard power cord is supplied with the set and this is simply fitted to the plug at the rear of the set. The makers claim that the whole operation requires only 30 seconds.

On test the set appeared to have ample sensitivity for car use and to substantiate the maker's claim of an average figure of one microvolt. Other features are that the set will operate regardless of the polarity of the car battery and that it can be supplied for either six or 12 volt operation. The makers also claim that suppressors are not necessary in the car.

FERGUSON CHARGER TRANSFORMER

FOLLOWING the article in last months *Radio & Hobbies* on trickle chargers and their value in preventing deterioration in batteries which are subject to intermittent use, Ferguson Transformers announce the release of a power transformer specially designed for this class of work.

The primary is normally designed for 240 volts while the secondary has two tappings, one at 11.5 volts for use with 6 volt batteries and the other at 17.5 volts for use with 12 volt batteries. The secondary is rated at .5 amp continuous, allowing



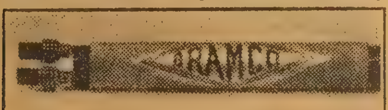
sufficient margin to enable the user to adjust the charging rate to suit a wide range of discharge conditions.

It is ideally suited for use with the disposal's rectifiers which were mentioned in the article and as many as necessary may be used to provide sufficient charging rate. Most other types of copper oxide rectifiers, normally used in chargers (notably the LT53) should also be quite suitable.

BRAMCO SOLDERING PENCIL

A RATHER novel soldering device recently released by Bramco Radio Components is the Bramco High Speed Soldering Pencil.

Main departure from conventional practice is the absence of the usual metal bit, the work to be soldered being heated directly by bringing it into contact with two spring-loaded specially designed resistance elements. When the job is sufficiently



heated solder is applied directly to it.

The unit is designed to operate from four or six volts, AC or DC, and is thus suitable for use with an accumulator or transformer. Any transformer rated at two amps is claimed to be suitable and most filament transformers would come within this category.

The makers also claim that it will do many jobs normally requiring a 100 watt iron, while it also has the features of almost instant heating and clean working. Because of the small size and light weight it should be very suitable for carrying in the tool kit of a motor car or even a motor cycle and should be more than adequate for emergency roadside repairs.

The retail price is 11/6 and the factory representative is A. J. Phillips Agencies, 27 Hunter St., Sydney.

LEARN WHILE YOU BUILD

(Continued from Page 41)

the one pin, a perfectly satisfactory arrangement in circuits for which this coil was originally designed, but one which presents some complications when we want to return the secondary to the AVC line.

We overcame the problem by removing the coil from its can and disconnecting the feedback winding (no longer used), from its pins, then using the most convenient of these to terminate the earth end of the secondary winding. After the coil has been replaced, the remainder of the wiring can be completed according to the circuit.

It is almost certain that the alignment of the set will be upset by the alterations and a complete realignment is recommended. When this is done and the original sensitivity restored, you may care to check the operation of the AVC with your multimeter.

This can be done quite simply by measuring the voltage across the cathode bias resistor of the 6AR7, the voltage varying from a normal value of between two and three volts with no signal, to a very much smaller value when a strong station is tuned in. This is due to the bias generated in the AVC system reducing the cathode current which normally generates the self-bias.

The behavior of the set with AVC is rather different from one without, and it may take a little practice to get accustomed to the correct way of handling it.

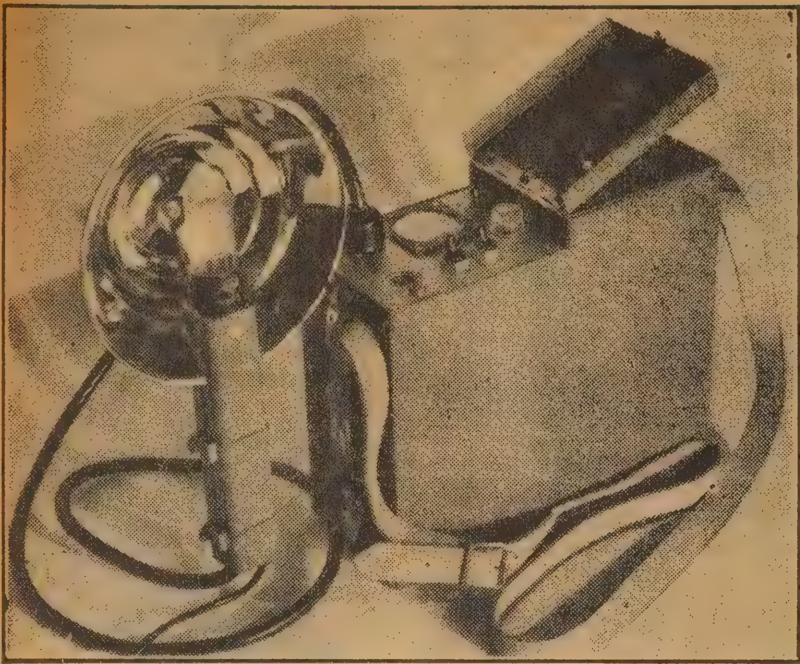
First impression will probably be that the set is more noisy, particularly between stations, which is simply due to the gain of the set advancing automatically to the "flat-out" condition as soon as the influence of a signal is removed. However, as soon as a station is tuned in the noise level will drop below it, exactly as with the original set.

SELECTIVITY

Another impression which AVC sometimes creates is that the set is less selective, but, once again, this is purely an illusion. It is created by the fact that the gain is raised as the set is detuned from a signal, causing the signal to occupy more space on the dial than previously. This does not mean that this signal would be any more prone to interfere with an adjacent signal — if it were there — because in this case the new signal would take over control of the AVC system, it only being in the absence of an adjacent signal that the first one seems to spread.

Tuning may appear a little more difficult, since it now has to be judged more on the quality of the signal than on the volume.

On the other hand, you will find the set very much easier to handle while searching for a station, since there is no fear of it being missed if it is a weak one or of it blowing the "innards" out of the speaker if it is very strong.



This picture is typical of commercial electronic flash equipment, and shows the customary arrangement of dividing it into two units; the flash gun proper, and the larger case, carried by a shoulder strap, which houses the heavier electronic equipment. Other designs vary in weight and light output to suit individual requirements.

ELECTRONIC FLASH UNITS

The era of electronic flash photography is now well established and there is a constant demand for constructional details of this type of gear. While there are still some problems to be solved—mainly in the matter of material supply—we are hopeful that we can describe such a unit. In the meantime this article covers some of the general aspects of the subject.

by Philip Watson

EVER since the earliest days of practical photography, photographers — both professional and amateur—have sought to beat the sun at its own game and to provide some form of high intensity lighting which would serve them through the hours of darkness or where the natural lighting was insufficient.

This problem of artificial lighting really fell into two categories: Studio lighting, and what we may call "mobile" lighting, the latter where the operator had to carry his lighting equipment, along with his camera, plate holders, &c, to the scene to be photographed.

EARLY HANDICAPS

In both cases the early worker was handicapped by both the generally poor lighting standards of those days and the slow emulsions and small lenses with which he was forced to work. In addition, most forms of artificial light were deficient in blue light, the portion of the spectrum where the early emulsions were mainly sensitive.

Studio lighting was the less serious problem. While early workers were forced to use natural light, the practical development of electric light soon put artificial lighting on a satisfactory basis, and this was to be steadily improved as engineers learnt more and more about lighting in the years that followed.

But the mobile worker was not so fortunate. At first he could do no more than make very long exposures by whatever natural light there was available, a process which was only practical if his subject was not likely to move for anything up to several minutes. This was a very severe restriction and generally meant that work was confined to inanimate objects.

Then someone hit upon the idea of illuminating the scene with a burst of high intensity light of just sufficient duration to make the exposure and so the idea of the flashlight was born.

While the idea was fundamentally sound, the means of execution were crude to say the least. The idea was to fire a charge of highly inflammable powder, usually a mixture based on magnesium plus other chemicals to improve the intensity and color of the light, while holding the shutter of the camera open for the full duration of the flash. This was known as the "open flash" technique and the main factors governing the exposure were the lens opening and the amount of powder used for the flash.

To fire the powder the operator used a flash pan, which generally consisted of nothing more than an "L" shaped piece of metal mounted on a handle, the horizontal portion of the L being curved into a container for the powder while the upright portion functioned partly as a reflector but mainly to protect the operator from the violence of the flash.

The method of ignition varied from simply dropping a lighted match through a hole in the back of the flash pan to elaborate systems of flints and wheels as used in petrol lighters. None of these were absolutely reliable and, particularly in damp weather, it was not unusual for the operator to make several attempts before obtaining a flash.

FIRE RISK

When the powder finally did fire the speed of combustion was so rapid as to virtually constitute a minor explosion. This presented a real danger in the presence of other inflammable materials, such as drapes and curtains, and in many public buildings the use of flash powder was forbidden because of this risk.

The resulting smoke was also a problem, in spite of special mixtures designed to eliminate this nuisance, and it was generally necessary to open windows and doors to clear the air after one or two shots, otherwise succeeding pictures would be spoilt by haze.

Apart from the risk of igniting nearby objects there was also the very real danger of serious burns to the operator or, indeed, to anyone else who was unfortunate

enough to be within a range of a few feet when the flash went off. Thus its use in a crowd was impossible, while many an operator was severely burned by pouring a second charge of powder into a flash pan not yet cool from the first firing.

Probably the worst effect, however, was that on the unfortunate subject, causing him to move or blink involuntarily as the flash went off. (Any flashlight photograph taken when father was a gay young spark will show half the subjects with their eyes closed.) This was not surprising considering the nature of the flash, with its broad sheet of flame, noise and smoke.

It has since been established that this involuntary action is generally sufficiently delayed to enable a satisfactory picture to be obtained if the exposure is made during the early part of the flash, but no such selection was possible and the flash duration was usually long enough to record all such movements.

NO ACTION SHOTS

It is also obvious that any form of high speed photography utilising the speed of the camera shutter, was quite out of the question, the uncertainty of the exact instant of the firing of the flash making it impossible to synchronise it with the shutter.

Considering all these limitations it is surprising that any worthwhile pictures were ever obtained, and the fact that they were is a tribute to the patience and skill of the photographers, rather than to the efficiency of the equipment they were forced to use.

What is even more surprising is that this form of mobile lighting remained virtually unchanged for something like 75 years, during which time studio lighting, along with other forms of lighting, had progressed to a high degree of efficiency, leaving the mobile worker completely behind with his primitive equipment.

The first real sign of progress came around 1930 when the first flash bulbs appeared on the market and in a few years these devices had reached such a state of uniformity and reliability that most professional photographers were inclined to regard them as the nearest thing to perfection that they were likely to get. They were light in weight, easy to carry, easy to fire, perfectly safe, quiet and clean in operation and, above all, reliable.

SYNCHRO-FLASH

In addition, it was not long before means were found whereby the shutter and flash could be synchronised, thus allowing high shutter speeds to be used to capture movement and putting artificial light photography on much the same basis as daylight photograhpy.

However, these devices have one disadvantage—high running cost. Whether this is serious or not depended to a large extent on how they are used. For the professional photographer the price of several shillings per flash is generally small compared with the wages of staff and models, while in Press work it may well be negligible compared with the news value of the picture.

TYPICAL FLASH PHOTOGRAPHS

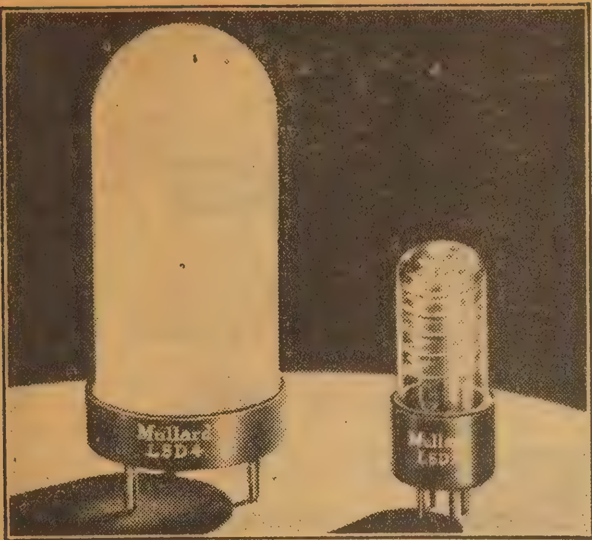
The ability to stop the fastest movements normally encountered is one of the features of the electronic flash and this picture is typical of the type of subject and the results possible. Note the complete absence of blur in any part of the picture.

To the amateur, on the other hand, who can seldom depend on a financial return for his work, this figure must usually be regarded as far too high. Admittedly there are some odd occasions when the personal value of a picture may justify the cost but, in general, the amateur feels that flash bulbs are essentially for the professional.

This is particularly so when the nature of the subject may call for a large number of exposures in order to be sure of only one or two usable negatives, a procedure which is sometimes condemned but which, nevertheless, is common practice.

Some professionals also follow a similar practice, taking pictures in the street or at social gatherings with no real guarantee that all or any of the pictures will be eventually purchased, the customer reserving the right to accept or reject the picture as he thinks fit. When using 35 mm film, purchased in bulk quantities, the cost per negative is small enough to justify this risk, but the use of flash bulbs is out of the question unless the customer is prepared to defray the cost in advance—some-

What it can do when it really tries! This is an electric light globe in the act of being smashed by dropping on a hard surface. Although only the lower half was broken at the moment of exposure the remainder was just as effectively smashed a fraction of a second later. The exposure was 1/10,000 of a second.



Two types of electronic flash tubes. The one on the right is a 100 joule type used for portable equipment while the larger one is a studio type having ratings of 400 or 1000 joules. The centre of these types is left open to admit a 100 watt modelling light.

thing which he is seldom prepared to do.

This is where the latest form of mobile lighting, the electronic flash, comes into its own. Although the first cost of the equipment is higher than other types, the running cost is very low and a unit will quickly pay for itself when used in a professional capacity.

It also has an attraction for the amateur, particularly those with some interest in electronics as well as photography, since there is a chance that he can build his own equipment for a moderate first cost and still have the advantage of low cost per flash. At the present time we are considering the possibility of describing such a unit, built from components available on the Australian market but, in the meantime, a discusssion on some of its properities should prove interesting.

EARLY ATTEMPTS

The present era of high speed electronic flash photography began with investigation around 1928 by Professor H. E. Egerton of the Massachusetts Institute of Technology into previous attempts to take photographs of objects moving at high speed. A rather remarkable aspect of this early history is that a suggestion was put forward, and patented over 100 years ago by none other than William Henry Fox Talbot, one of the principal pioneers in the art of photography itself.

Talbot suggested that the light from an electric spark might be used to illuminate objects travelling at high speed and that the period of the spark could be made extremely short by correct design of the associated electrical equipment. Not much appears to have been done in a practical way along these lines at the time, probably because the slow emulsion speeds and the crude electrical equipment was not equal to the task, but some 40 years later the idea was revived by Professor Mach and Sir Charles Verno Boys in London.

Using a charged capacitor to supply the electrical energy and a spark gap in a reflector as a source of light they made some remarkable pictures of bullets in flight in which the movement was completely stopped and the air or sound waves were clearly visible. One of the secrets of their success was the means of firing the flash, the bullet itself serving to complete the electrical circuit as it passed over a pair of contacts.

Another important point was that no actual camera was used, the bullet being simply fired between the source of light (the spark) and the photographic plate, and as close to the latter as practicable. This resulted in a silhouette rather than a more conventional front lighted picture, but this was, nevertheless, extremely useful and, at the same time, avoided the considerable loss of light which would have been involved had the image been passed through a lens.

EGERTON'S WORK

In spite of the success achieved little more appears to have been done until Professor Egerton commenced his experiments, probably because, as before, the limits of the then available equipment had been reached.

Egerton retained the idea of a charged capacitor as a source of power, but made a major contribution in the manner in which he transformed this power into light. Even with the vast improvement in sensitivity of modern emulsions, it was clear that the light given by an electric spark was woefully inadequate for anything except simple silhouettes, and there were

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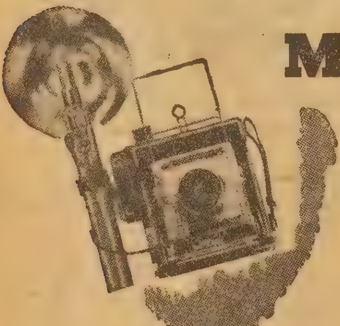

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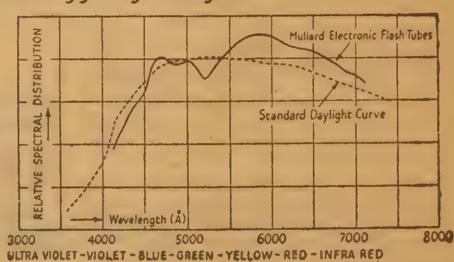

Spectral distribution curve of Mullard Xenon-filled Electronic Flash Tubes

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only a few subjects which lent themselves to this class of picture.

A much more efficient method of producing light, while retaining the advantage of rapid response, is the passing of current through a suitable gas, causing it to ionise and give forth a brilliant light. This was really the main secret of Egerton's success and it may be beneficial to study some of the characteristics of these gaseous discharge tubes.

The simplest example of these is the humble neon lamp used as a pilot indicator in power points, &c, while fluorescent lights for general illumination and neon advertising signs also operate on the same general principle.

IONISATION

These lamps consist, essentially, of a glass tube containing two electrodes and one of a number of suitable gases. With no voltage applied to the electrodes the resistance between them is almost infinitely high and this condition is retained as the voltage is raised until a certain critical value, called the ignition voltage, is reached.

At this point the gas ionises, becomes conducting, and the resistance of the tube falls to a very low value, often only a few ohms. Under these conditions the current flow is likely to be very heavy, so heavy in fact that the tube will rapidly destroy itself unless the circuit is so arranged that the current is limited in some way.

In the case of the neon pilot light a small resistor in the base, with a value of several thousand ohms, provides the necessary protection while in larger installations inductors are used to avoid waste of power.

The color of light produced when the gas ionises is dependent on the type of gas or mixture of gases and a wide range of colors is possible. For photographic flash tubes the gas xenon with small quantities of mercury vapor is used and the resulting light so closely resembles daylight that it is possible to expose color films without the need for compensating filters.

Another characteristic of these tubes is the "extinction voltage," or the voltage below which ionisation ceases after having been started at the ignition value. The extinction voltage is always lower than the ignition voltage so that, once the gas ionises, the voltage may be reduced considerably without loss of ionisation. This is an important characteristic, since it is made use of in firing and controlling flash tubes.

TRIGGERING

In practice, tubes are designed to operate at voltages well below their ignition voltage and, as a result, they may be left permanently connected across the main storage capacitor even when this is fully charged. When it is desired to fire the tube an auxiliary or "triggering" voltage of three or four thousand is applied to a triggering electrode and the gas is ionised.

Because the voltage across the capacitor is well above the extinction voltage the gas remains ionised at this lower voltage after the trigger voltage is removed and the total stored energy is released through the tube.

Egerton's original lamps were straight glass tubes, somewhat after the style of modern fluorescent lamps, though smaller, and were used in conjunction with special reflectors. With these it was possible to produce light flashes of extremely short duration, in the order of 1/10,000 second, and they introduced a whole new phase of photography, both still and motion picture.

Phenomena which had previously been regarded as virtually instantaneous could now be slowed down to occupy several seconds or even minutes of projection time, permitting a detailed study of movements which had previously been a complete mystery.

Similarly, still pictures were able to arrest high speed movements at any stage and needle sharp pictures of breaking light globes, splashes of liquid, birds in flight, &c, became commonplace. While these were essentially novelty pictures, industrial engineers were quick to appreciate the significance of such photographic possibilities and quickly availed themselves of the opportunity to solve many of the mysteries of high speed machinery.

Thus the motor car industry was able to study such problems as the correct seating and the elimination of bounce in engine valves, the performance of high speed fuel injection systems in Diesel engines, and the behavior of lighter fuels in standard carburettors. The jet engine has also been helped to its present state of perfection by the ability of these remarkable devices to record exact details of fuel atomisation, turbine blade flutter, and many similar problems.

HEAVY CURRENT FLOW

The next step was the introduction of this form of lighting to commercial photography and to adapt the tubes for use with standard photographic reflectors. To do this the original straight tube was formed into a compact helical coil occupying no more space than a standard flashbulb.

When used for photoflash work no limiting resistor is used with these tubes and when the gas ionises the only limitation on current flow is the resistance of the tube itself. The only reason why this does not result in complete destruction of the tube is the limited amount of energy which can be stored in the capacitor.

The lower the resistance of the tube when it ionises the quicker the capacitor will be discharged and the shorter will be the flash. Tubes for special applications may have a resistance as low as .5 ohm and will discharge a condenser in as little as one microsecond (one millionth of a second). Tubes for more general applications may have a resistance of four or five ohms and are relatively slower, requiring about 200 microseconds (1/5000 second) to discharge the condenser.

Nevertheless, this so called slower speed is extremely fast compared with normal shutter speeds and is capable of stopping almost any kind of movement, such as rotating fan blades, shattering glass or crockery, &c, while the ordinary movement of a restless sitter or the leap of a ballet dancer can be easily handled.

It will be fairly obvious that the size of the capacitor will also govern the duration of the flash and, all else being equal, the greater the capacitance the longer the flash.

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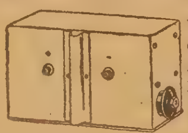

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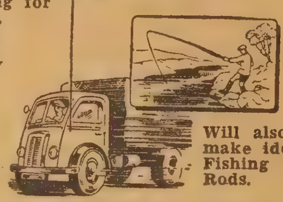

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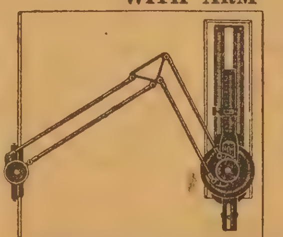

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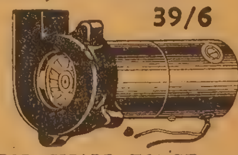

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Where the flash duration is of major importance, as in special scientific studies, the capacitance is kept small, even though this means a reduction in light output.

An increase in operating voltage will help to increase the light output as well as the speed of discharge though, obviously, there is a limit beyond which it is not advisable to operate the tube.

Fortunately, most scientific applications do not call for large areas of illumination and the reduction in light is not serious but, at the same time, most tubes intended for this class of work are designed for operation at high voltages (five to ten thousand volts).

The shortest exposure which appears to have been achieved by this method is one fifth of a millionth of a second, used by the American General Electric Co. engineers to photograph bullets in flight. (If you can grasp the full significance of this extremely short duration of time you're a better man than I.)

COMMERCIAL PRACTICE

For more conventional every day photography the length of the exposure is of much less importance than the intensity of the light and normal practice is to adopt more moderate voltages (between two and three thousand) and to use the maximum capacitance permitted by the ratings of the tube as well as such factors as weight and size.

The first use of electronic flash tubes for commercial photography was in the form of studio lighting systems and in this form they did not present any particular problems from an electronic point of view since, within reason, there were no serious limitations on size and weight and the whole unit could be designed for optimum performance. The heavy electronic gear was usually carried on a small wheeled trolly, the lamp and reflector being mounted on an adjustable stand on the same trolly and the whole unit moved as required for various lighting angles.

Power was obtained from the mains and stepped up to the required voltage by means of a transformer, rectified with a valve or valves, and the resultant DC used to charge the condenser. Various methods of interconnection were evolved whereby several units could be synchronised and made to flash simultaneously thus making possible standard studio multiple lighting effects.

MANY ADVANTAGES

Another feature was the inclusion of a modelling light within the flash lamp to provide a means of setting up the lamps and foreseeing the effect of the flash. The modelling light consisted of either a standard filament within the tube or a separate filament lamp mounted in a space provided in the centre of the tube.

Although originally regarded as a form of "special" lighting for difficult subjects, photographers soon found that these lamps could be used for all regular forms of photography where incandescent lamps had previously been used—and with a number of advantages. As a result many studios now use this type of lighting exclusively and its popularity is rapidly increasing.

Some of the advantages which are claimed for it are as follows:

(1) The duration of the flash is so short that subject movement ceases to be a problem and more natural pictures result.

(2) A complete absence of heat compared with the many kilowatts of power concentrated on models with standard lamps.

(3) A worthwhile saving in running cost by eliminating the kilowatts of power refered to above as well as the elimination of special heavy duty cables, power outlets. &c.

(4) the color is right for natural color film and remains correct regardless of variations in applied voltage or with the age of the tube.

Once the electronic flash had established itself in the studio, photographers began to consider the possibility of using a portable version as a substitute for flash bulbs, reasoning that a small power unit, weighing only a few pounds, and capable of delivering a large number of flashes of the same brilliance as the studio units would be a much more economical proposition and at the same time provide the advantages of high speed flash.

Unfortunately it was not as easy as all that. Studio units used a total capacitance of from 100 to 200 mfd operating at voltages between 2000 and 3000 and capacitors of this order just cannot be made in vest pocket sizes. Added to this there must be some form of portable power, such as a small accumulator, a transformer to increase the voltage, a vibrator, and sundry components, all of which added up to a size and weight which was about as portable as an army pack.

TYPICAL RATINGS

However, it was found that in most cases the full output of the studio lamps was not required and, by adopting a compromise design, it was possible to reduce the weight to more reasonable proportions. Nevertheless it does not seem likely that these units will ever be reduced to a mere one or two pounds in weight, at least not at the present state of the electronic art, and something around ten or twelve pounds appears to be about the best effort without a serious reduction in light output.

The performance of these units is usually expressed by quoting the electrical energy released when the tube is fired, using the unit of energy, the joule. (1 joule equals 1 watt for 1 second.) A popular size of studio lamp would be rated a 400 joules and several such lamps would be used on occasions.

For portable work a figure of 100 joules appears to be about the maximum that can conveniently be provided and, with a good reflector and fast film, can be used at distances up to about 15ft with modern fast lenses. It is impossible to lay down hard and fast rules in this respect, since there are many variable factors, such as type of film, method of processing, permissible grain, &c, which all effect the final result.

To achieve the rating of 100 joules, a capacitance of 27 mfd at 2700 volts or 50 mfd at 2000 volts would be required and such a condenser might weigh anything from six to 12lb.

A popular rating on many commercial units is 60 joules, while a few, intended mainly for close working, have been rated as low as 30 joules. The main advantage of the lower ratings is reduction in weight,

(Continued on Page 96)

OFF THE RECORD — NEWS & REVIEWS

How much power is needed for satisfactory reproduction of records? I've been reminded of this question by a couple of letters which have come in through the mail this month. One of them questioned my contention that we could do with milliwatts instead of watts.

BY JOHN MOYLE

BEFORE being too dogmatic about the subject, there are one or two things we must consider to clear the air for our ideas.

In the early days of electric reproduction we were faced with quite a problem in order to convert our electrical output into sound output. This, of course, is the function of the loudspeaker and its coupling device—usually a transformer. Into its primary we feed a certain amount of electrical power. The transformer conveys this power (or part of it) into the secondary winding, and thence to the voice coil of the loudspeaker.

The loudspeaker in turn can be considered as an electric motor, the duty of which is to vibrate the cone.

It doesn't take an Einstein to realise that the amount of sound we are going to realise from all this depends upon the efficiency of the loudspeaker circuit in converting electrical energy into sound, and the efficiency with which the loudspeaker cone is able to disturb the air into vibrations.

Now the first dynamic speakers were lamentable in this regard. Their coupling transformers were responsible for an appreciable amount of loss, and the speakers for still higher amounts. Mostly the magnets were of the energised types, and the poles made of material which couldn't accommodate many lines of force without saturation. Voice coils and cones were heavy, and moreover suffered badly from moisture absorption.

I'd hate to estimate how much of the available power was thrown away in just making them work.

WASTE POWER

The standard method of mounting such speakers was on a flat baffle as the alternative to a rather boomy cabinet. Compared with modern practice, this is not a good method to provide loudspeaker coupling with the air. After all, it's not much use having a cone vibrating without good coupling, any more than it is having a motor car engine running with a slipping clutch.

The net result was that, in order to get plenty of sound, we had to supply most of the power to overcome losses in the system, and our amplifiers had to be built accordingly.

There is another more psychological point involved here. Because of the restricted frequency range of the speakers, the tendency was to run them at a higher than normal volume in order to achieve the impression of enough sound. Those of you who have used wide-range speakers will know that you tend to operate them at a lower level—often a much lower level—in order to achieve balance, which is really the most important factor in satisfactory listening.

Today's picture is quite different. Most serious amplifier users employ first of all high grade speaker transformers, which have a very good efficiency.

A high-grade speaker today is a totally different proposition from that of bygone years. Practice today is to use permanent magnets using alloys, giving a vastly stronger magnet, and pole pieces which are able to concentrate many lines of force without saturation. This alone is responsible for much greater sensitivity, which means that the speaker needs much less electrical input for the same sound output.

Then, again, speaker mounting has received considerable attention of late. Enclosures have been developed—specifically the vented enclosure—one feature of which is to step up efficiency still further by improving the coupling efficiency of the speaker to the air it is supposed to move.

There are other effects brought about by these successive improvements, but for the moment I am concerned only with the fact that today's speakers need much less power for their operation than they did in the past.

The statement queried by one reader occurred in an article on the Playmaster series of amplifiers. It was to the effect that I had measured the amount of power being used for moderate volume listening, and had found it to be no more than about one-quarter watt or thereabouts.

I was therefore most interested to read a paper recently published by H. F. Olson and A. R. Morgan, of the RCA laboratories in America, where some of the most important sound work in the world is carried out. Basing figures on listening tests in RCA laboratories, the authors state that power inputs of only 50 milliwatts, or .05 of a watt, were required for an average sound level of approximately 80 db., a level which has sometimes been objected to as being too loud, but never as being too soft. From this they deduce that the ordinary home would probably be satisfied with an average of only .016 of a watt, which again means that, allowing for a 10 times increase for maximum peaks, the amplifier need not produce more than about .5 watts for home use.

LOUD VOLUME

This conclusion, although somewhat borne out by my own observations, should not lead to false conclusions. This point is also appreciated by the authors referred to, who agree that there are many people who like to hear loud volume on orchestral music, for instance, which would be represented by a much higher db level—say 100 db. Their conclusion, therefore, is that even for these people, a maximum output of 5 watts would be ample.

This is nearer the mark as a design figure, and more in line with my own conclusion as expressed or implied in the same series of Playmaster articles.

It can be assumed, I think, that the loud speaker efficiencies used by Olsen and Morgan would be high—quite as high if not higher than those to be met with by the builder of home equipment, who uses the best speakers available. I think, therefore, we would be justified in saying that, for the high volume enthusiasts, something in excess of 5 watts would be desirable.

There is another quite important

factor here. The distortion from an amplifier is much higher at or near full output than it is at say half output or less. It isn't the best, therefore, to reckon that if 5 watts maximum is required, the amplifier need not give more than this. So it works out that, up to the 5 watts mark, which normally will not be approached for medium levels, a single 6V6 with feedback is just about right. For large volume, it is better to use a pair of valves with a maximum of about 10 watts. This means that distortion at useable volume will be very low, and in any case the limit of a single 6V6 type valve is about 4.5 watts.

ACTUAL FIGURES

The conclusion, therefore, is still that the design of an amplifier will be set largely by the upper limits of volume which will be required—up to 4 or 5 watts on the one hand, and to some higher figure on the other. The fact that quiet listening, which will occupy much of the playing time for both amplifiers, needs only a fraction of a watt with a modern speaker, merely underlines the point I have made, and borne out by Olsen and Morgan, that at this low level distortion will be completely negligible with a well designed amplifier.

Leaving volume level, and proceeding to discuss distortion again for a moment, these authors conclude that distortion is more easily appreciated at low levels than at high levels, the maximum distortion being detected at about the figure generally required for average listening.

Now at this point, they estimate that the critical ear can detect distortion of about .75 pc. At loud volumes, up to 3 pc can be tolerated, due to the failure of the ear to appreciate distortion as the level increases. This I feel is probably an accurate enough estimate, but an estimate it must remain. I have made enough experiments to test the limits of the human ear to be satisfied that not only does the response to higher frequencies vary anywhere between 10 kc and 18 kc, but that the appreciation of distortion varies in just about the same ratio. This isn't surprising when we remember that it is the higher order of harmonics which are the most distressing, and, of course, they represent high frequencies added to a correspondingly lower pitched fundamental.

WHAT TO AIM AT

I would say, therefore, that these figures of distortion are higher than desirable when designing equipment. In fact, if I were to hazard a dangerous guess, I'd say that 1 pc at full output is enough. If this is achieved, and I see no reason why it should not be, there would be nothing like .75 pc present at less than 1 watt. I do not think it is worth while going to any great trouble to improve on these figures, which brings me back to the original basis of the Playmasters—to design for about these amounts without accepting any improvements if they involve the danger of instability or difficulty in building and operation.

Not only does this split at about 4.5 watts appear logical in matters of required output and permissible distortion, but it is logical also in matters of economics. As illustrated by the Playmasters and others, two valves are the fewest which can be used in any useful amplifier, whether its maximum is .5 watts or 5 watts. It would therefore cost the same amount of money to make one as to make the other. If reserve power means less distortion, and has no disadvantages, then why not have it?

Conversely, it isn't easy to get more than 4-5 watts from a single valve, but quite easy to get 10 and over from two. Hence the second step is a push-pull job using say two 6V6's. It is very rarely that such an amplifier will not give enough power, but should this happen, a pair of 807's in push-pull — a much more costly solution—can be considered.

THE HAM BANDS WITH BILL MOORE

Amateur radio operators in the US are provided with plenty of opportunity to join officially in the various operating fields by accepting appointments made available by the communication section of ARRL.

THIS section is highly organised and paid officials fill the following positions:— Communications Manager, Deputy Communications Manager, Assistant Managers — one for CW and one for Telephony, and National Emergency Co-ordinator.

Away from head-quarters the continental area is divided into sections, their size depending on the density of station population. Sometimes a whole state is included in a section, but New York for instance is divided into three sections.

Each section has its own communication manager (SCM) elected by the members of the area, and he is responsible for the organisation of section stations, the providing of monthly notes for QST, and the recommendation of individual stations for ARRL official appointments.

Stations that have been licenced for one year or more are eligible for appointments and depending on vacancies the following official station appointments are available to amateurs. One point that should be remembered is that the US amateurs are permitted to handle third party messages and a number of the positions would be redundant here.

Emergency co-ordinator (EC): The main duty of amateurs appointed to this position is to effectively organise amateurs in his area for emergency service. He too must supply contact between his group and authorities likely to require communication assistance, and to co-ordinate the amateur service as requested.

Official Relay Station (ORS): These stations are active in traffic handling in the various nets and traffic lines. Thousands of messages are handled monthly in the US and it's possesions, many of these are originated by and directed to servicemen in the Pacific and Europe.

To obtain an idea of the amount of traffic handled, leading stations in the official ARRL monthly lists were: W3CUL who originated 472 messages, received 47600, relayed 4202 and delivered 525; K4WAR for the same month originated 2639 messages, received 698, relayed 601 and delivered 97. Needless to say these stations use more than one operator.

Official Phone Station (OPS): The main purpose of these appointees is to set an example in voice operating procedure and techniques.

Official Experimental Station (OES): Station appointments are available to all amateurs experimenting in any field, i.e. VHF, UHF or HF propagation, Facsimile, TV &c.

Official Bulletin Station (OBS): Normally engaged in transmitting ARRL and FCC bulletins and information for amateurs.

Official Observers (OO): Observers send co-operative notices to amateur stations to assist them to keep within frequency limits and ensure high quality signals. The main purpose is to prevent official FCC action being taken against offenders. In Australia, advisory committee members act in a similar manner, although as can be seen, the method of operation is different.

Suitable certificates are available to all holders of official positions.

A TRIBUTE TO WAL RYAN — VK2TI

The sudden passing on April 16 of Wal Ryan, VK2TI, one of Australia's best known amateurs was recorded in last month's issue. Wal's associations with the hobby were so extensive that the following record of his work is an example to all amateurs.

For a period approaching 20 years his work as an administrator, earned him a reputation well known to amateurs throughout the Commonwealth.

To trace the activity of VK2TI in amateur affairs from 1935 to 1946, is in fact, to trace the history of the NSW Division — they were so closely allied. It is extremely difficult to estimate the true value of Wal's work on behalf of Australia's amateurs. He was responsible for the consolidation of the NSW Division during very difficult years.

He gave of his time unstintedly in the cause he championed — the WIA — with the unfortunate result that his health suffered.

In 1946 he resigned from the position of NSW Divisional President on the advice of his doctor.

Last year again, he took an active part in amateur affairs when he accepted the chairmanship of the Federal Jubilee Contest Committee. The results of the Jubilee Relay and Jubilee VK/ZL DX contest — so highly successful — clearly reflected Wal's organising ability. The Commonwealth Jubilee Celebrations Committee placed on record, an appreciation of the work of Wal and his committe in publicising throughout the world Australia's Jubilee.

1930 CRISIS

It will be remembered, that the NSW Division of the WIA ceased to function as an amateur organisation in 1930. At that time the members voted the body into liquidation to form the IRE. Radio amateurs then formed the Associaton of Radio Amateurs (NSW). In 1935 it was found possible to take over the division and from that date, it was Wal's ambition to firmly establish the division in its proper sphere as the representative amateur radio body for NSW.

Wal through the years has been elected to every major office in the WIA organisation. His first position was as Publicity officer of the old established Waverley Radio Club, and in turn he graduated to State Secretary, Federal Councillor, State President, Federal Secretary, and Federal President of the WIA.

In 1947 was elected a life member of the NSW Division in recognition of his services to amateur radio.

It was due essentially to Wal's efforts that the NSW division successfully conducted in 1936 a radio exhibition at the Assembly Hall, Sydney, and in the following year a similar show was held in the Sydney Town Hall.

During the war years, he organised a section of the National Emergency Services in Sydney when amateurs were active in NES work. He entertained during the period many servicemen at his home, including the many overseas amateur visitors. He performed too during this difficult period valuable service to the hobby by keeping the divison together, and also by his work on the Federal Executive which during the war years was transferred to Sydney. He acted too as editor for "Amateur Radio." Post war he inaugurated the official VK2WI Sunday broadcasts as we now know them, the idea was later taken up by the other divisions.

KEEN OPERATOR

Despite the many hours Wal spent on administrative affairs, he was well known in the operating field especially in DX work. He was an early winner of the ARRL DXCC, in 1936 obtained his WAC and pre-war he was one of the few stations to hold a WAS. In fact, Wal had many good friends amongst the American amateurs and was always active in the ARRL DX tests being the leading VK competitor on one occasion. He was interested in the UHF's and back in 1937 was running push-pull 808's on 56 Mc/s. In 1938 he appeared on the "Hamdom" page in QST as one of Australia's best known amateurs, in the short time to 1938 Wal's work had created a lasting impression.

Wal's life was a full one — he enjoyed the associations of our hobby, and made many lasting friendships in amateur radio He was exacting in all his work and expected the same of others. In the interests of the hobby and particularly the Institute, time or effort was no object, provided he could attain the result at which he aimed. On one occasion he journeyed back from the midst of his holidays to attend a WIA function, such was his deeply ingrained sense of duty

Australia's amateurs have never seen a more efficient administrator in our hobby, and his record will be an example to any who care to follow and give of their leisure time for the furtherment of amateur radio.

Amateurs throughtout the Commonwealth extend to Mrs. Ryan and her family their deepest sympathy in their loss. They too appreciate, the support afforded Wal by Mrs. Ryan in his work, a material contribution to the Wireless Institute of Australia and amateur radio.

NEW 21Mc BAND

Conditions could not have been worse for the opening of the new 21Mc band, and during May, according to reports, no outstanding contacts were recorded.

English stations at the time of writing, had not been granted permission to use the band despite several approaches to the GPO by the RSGB on the subject.

The 21Mc band was opened to American and Canadian amateurs from May 1. In order not to delay the opening, operation was restricted to CW only. Definite sub-allocations for telephony and CW are made for all bands over there and discussions will be shortly held with reference to the use of other modes of emission on 21Mc.

The RSGB has forwarded to the IARU headquarters a letter pointing out the decision of the Paris (1950) IARU Congress in regard to the division of the band for telephony and CW. They ask that the ARRL be informed of this recommendation before they act re subdivisions. The following frequency limits were suggested for a world basis:

21,000-21,150Kc telegraphy only, 21,150-21,450Kc telephony and telegraphy.

The month's operation produced only a few Europeans HB and DL the only prefixes heard. VK2AHA contacted a PY. DX men VK2DG, VK2GW and VK2RA and others have been investigating the possibilities of the band, but it appears that conditions will have to improve before anyone will be able to gauge how the band will behave.

The 21Mc contest running through July and being conducted by the LABRE, The Brazilian National Society, may provide some interest. Stations in Brazil will operate over the four weekends and overseas stations are requested to supply reports on the PY station's operation.

CW will be used on two weekends, July 12 to 14, and July 26 to July 28 from 0301 GMT Saturdays, to 0301 GMT Mondays. Telephony will be used on weekends, July 5 to July 7 and July 19 to July 21, between the same times.

Any reports should be sent to LABRE, PO Box 2353, Rio de Janeiro, DF, Brazil.

CW stations will operate between 21,000 to 21,150Kc and telephony stations between 21,150 to 21,450Kc.

"THE HAM'S INTERPRETER"

The Hams Interpreter, written and published by Pentti Aarnio, OH2SQ, is now being used by a great number of amateurs.

The booklet contains sentences and expressions commonly used in amateur parlance in English, French, Spanish, Italian, German, Swedish and Finnish.

Pronounciation of the letters of the alphabet and numerals in all the above languages are covered. The main body of the book is divided into sections covering all phases of activity from the original "CQ" to "73 and good DX OM." A model QSO is also interpreted.

If anyone desires to obtain the greatest interest from his foreign telephony contacts, the booklet is invaluable.

It contains 37 pages and is available at a cost of 5/- post free from Gage and Pollard, 55 Victoria St., London, SW1.

GENERAL ITEMS

Singapore Island VSI and the Malayan Federation VS2 are now separate countries. Contacts made since 1946 when Singapore was announced a Crown colony will count for the DXCC and other awards.

The number of cards handled by the official QSL officers have dropped by 50 pc since 1949. This signifies a dropping off in the number of contacts, the IARU HQ's points out that this may be due to poorer radio conditions, but it also appears that the flush of activity after the ban over the war years is falling off. The next two years or so should decide whether the amateur population will continue to increase.

G2FSR makes a few pertinent points on DX contests in the RSGB Bulletin. He suggests that first place in these contests is a privilege reserved for those who, (a) choose to exceed their licence power, (b) are able to erect aerial systems beyond the scope of the average city dweller, (c) (applicable to G's or W's) due to their location are still able to operate during TV hours.

Further appointments made by the NSW Divisional Council for the ensuing year are Fred Phillips, VK2ZQ, as vice-president, and Stan Owen, VK2RX, as treasurer, both are well known to amateurs.

With the re-introduction of the monthly bulletin, the following amateurs are responsible for its production, Maurice Butler, VK2AAN, compilation, Roy Pearce, VK2IV, printing, and Peter Vesper, VK2PV, despatch.

The vast improvement in the last few years in the technical and general information provided monthly in the RSGB Bulletin, makes the journal a must for the amateur shack. It provides a new slant into amateur practice where problems over there are generally solved in a less grandiose manner than in the US.

The bulletin is available here only to members of the RSGB—membership rates however are very reasonable and for Corporate Members (overseas) is only 15/- sterling per annum. The address of the society is New Ruskin House, Little Russell St., London, WC1.

THE UHF'S

The many country stations now operating on the 144Mc band are gradually increasing their range, and a number of them are reaching out over the 100-mile figure under suitable conditions. With improved equipment and antennas, and the use of CW where necessary, quite a good portion of the Eastern States are effectively covered.

VK2WH, for instance, is now covering the 180 miles to Sydney over the 3500ft high Blue Mountains. He has contacted VK2ANF and VK2MQ besides hearing other stations. He has been heard, too, by Norm Moody in Coonamble, the distance, 160 miles.

The VK6BO/VK5GL and VK2AH/ZL3AR contacts on 144Mc have been receiving due publicity in overseas journals. In some journals VK6BO and VK5GL were only credited with covering 1150 miles. In fact both QSO's were within 50 miles of the present world record of 1400 miles held by W6ZL and W5QNL.

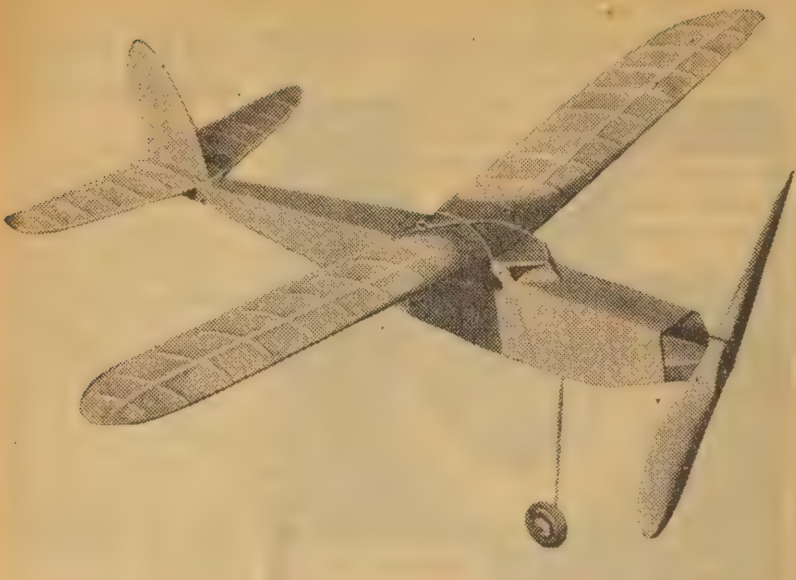


Figure 1. A three-quarter front view of the completed model. The article covers each step in its construction and adjustment. The description and plans are presented by arrangement with "Practical Mechanics" (London).

A REALISTIC FLYING MODEL

Though it is some time since we described a model plane, we make amends with this complete description of a high-wing, cabin-type monoplane. Carefully constructed, it is capable of turning on an excellent performance. You can scale up our drawings to prepare your own plans or obtain a full-scale blueprint through our query service for 3/6.

THIS small, easily-transportable lightweight rubber-driven model has been designed for really sound stable flight. With this aim in view, the model was kept simple and on proven lines, with a reasonable-sized propeller, and a deep fuselage forward to give good spiral stability.

The model is simple to fly, possesses a great spiral stability when reasonably well trimmed according to the flying directions, and has a beautiful glide.

Although it is a duration model, places where exceptional stresses occur, such as the nose and where the undercarriage is located, are adequately reinforced by sheet covering and plastic wood. A great deal of interesting and instructive general-purpose flying can be had with this model.

EASY TO BUILD

The two diagrams show stage-by-stage construction, and these instructions are augmented by this article. As a result, even a beginner should have little difficulty in making a successful model.

Newcomers to aero modelling should pay particular attention to accuracy of the fuselage outline, which will automatically give the correct angles of incidence to wing and tail.

Care should also be taken over the paper-covering methods described to ensure that there are no warps in wing surfaces or twists in the fuselage. No model will fly with twisted or warped surfaces.

Let us now run through the constructional details, commenting on these stage by stage, with some notes on test flights at the end.

A building board is advisable, but any flat surface, such as the top of a wooden box or table will do if a board is not available. The advantages of a board are that no one will disturb the operations in order to demand the table for other purposes.

A half-finished operation can be left to set the cement, until the constructor can find an opportunity to do the next job on the model. Any thick wooden plank with no twists is suitable as a building board.

The plan has had to be produced with the fuselage and wings "cut in halves" for economy of paper reasons. These "half components" should be carefully cut out and joined accurately, being pasted down to a paper packing. Any piece of paper will do, provided the lines of the fuselage are kept accurate, for these lines give the correct trim of the model.

Place the plan on the board and pin over the plan a sheet of grease-proof paper. This will prevent the balsa cement used for glueing joints sticking to the plan. Pins for construction are ordinary domestic pins. Pin the longerons down to the board.

Each fuselage side longerons are laid on top of each other as the two fuselage sides are built together.

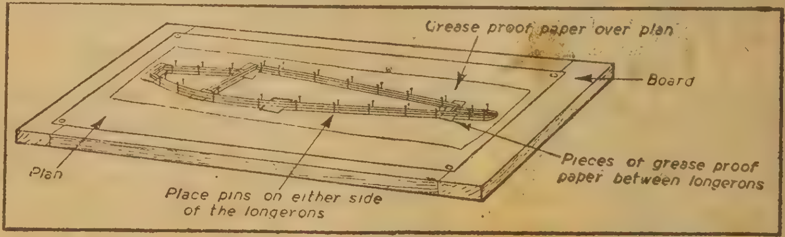


Figure 2. Pinning down the fuselage outline to the building board.

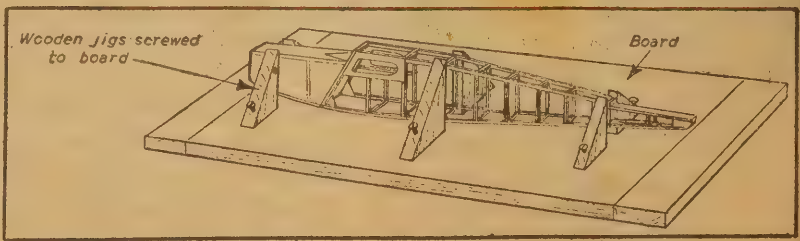
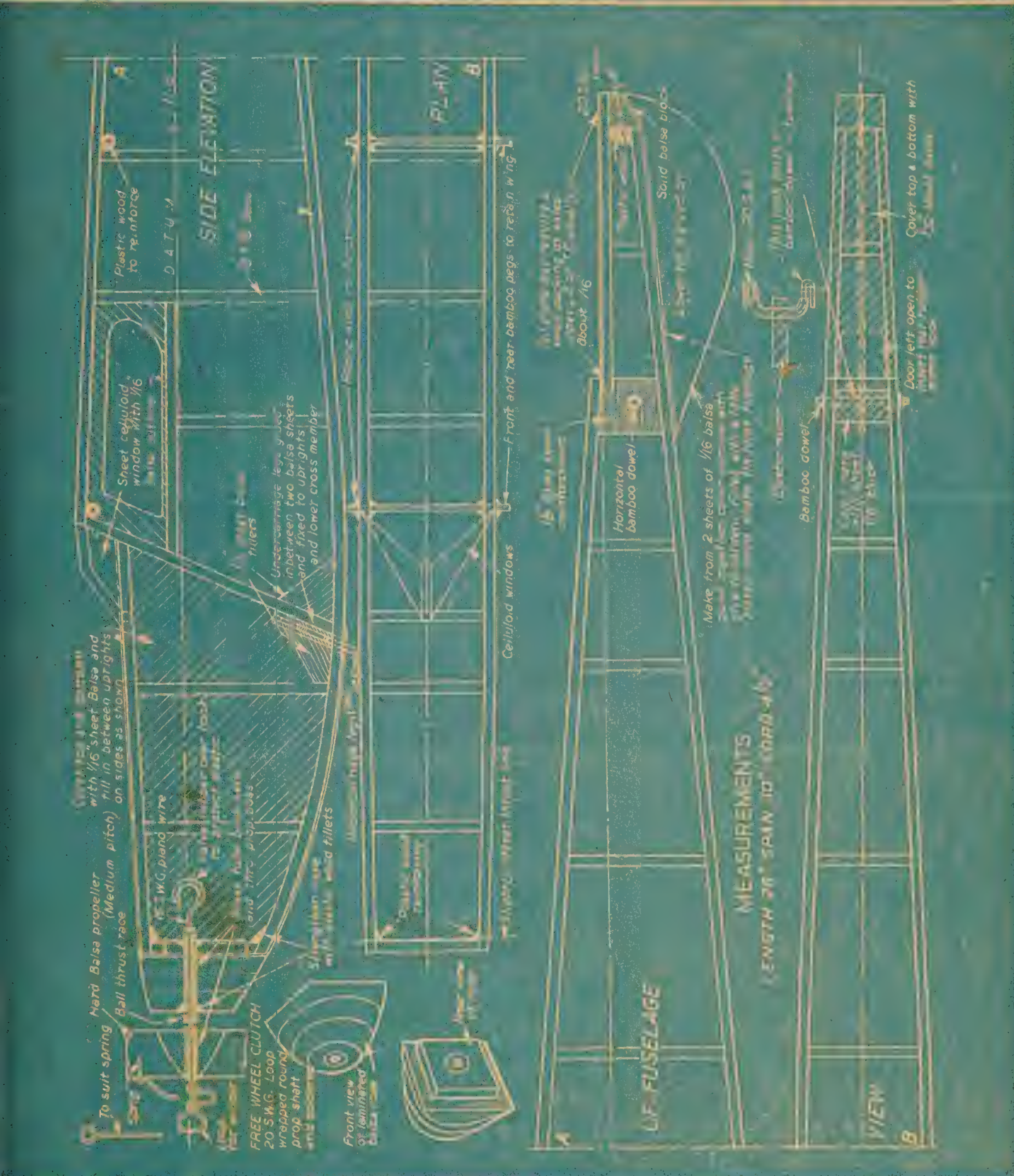


Figure 3. Simple jigs, screwed to the building board, keep the fuselage true and free from twists as the cement dries.

HALF SCALE PLANS OF THE FUSELAGE AND MOTOR



You can either scale these plans up 2:1 yourself or obtain a full-scale blueprint from our office for 3/6.

'his saves time and makes for acuracy. The pins are placed each ide of the longerons in order not o weaken the wood by piercing.

Where the uprights come, tiny ieces of grease-proof paper are nterposed between the bottom and op longeron. This will prevent the ongerons sticking to each other then the uprights are cemented in.

Where a longeron has a sharp end a little soaking in water is dvisable before pinning into the lines of the fuselage. This applies to the bottom forward run of the fuselage. (See Fig. 2.)

Now, cement in the uprights, with plenty of cement at the joints. It never pays to be sparing at joints with cement. A quick-drying balsa cement should be purchased.

When the cement is dry, separate the two sides of the fuselage carefully with a razor blade, of fine one-edge type. This is also used for all cutting of balsa wood. Clean up the joints and then place the two sides upright, having previously cemented in the side windows of very light sheet celluloid.

These two sides must be absolutely vertical and at the right distance apart according to the plan, so that the four widest crosspieces can be cemented in. When the cement is quite dry, the nose and tail crosspieces can be cemented in, keeping these sprung in by temporary pins until the cement is dry.

Be very careful at this stage not to pull the fuselage out of line or twist it. This is the diffcult period. When the cement is dry at nose and tail, the remaining crosspieces, of widths according to the plan, can be cemented in at the correct stations, slightly springing out the longerons.

If accuracy and ease of building are sought, as they should be, it always pays to make a simple jig to get the fuselage true. This can be done as shown in Fig. 3.

Remember that a twisted fuselage or a lop-sided fuselage will never permit accurate flying, as wing and tail will be out of line with each other.

It is quite possible to build without a jig, if one is reasonably skilled and is possessed of an accurate eye but a jig ensures accuracy and is often worth the time spent. Furthermore, if a second fuselage is required at any time, a jig saves trouble.

PLASTIC WOOD

Fittings such as wing retaining dowels of hardwood and tail hook, the undercarriage, etc., all shown on the blueprint in detail, should now be made and fixed to the fuselage. When these items are fitted they should be reinforced by plastic wood smeared to the sheet balsa covering at these points, which it will be observed are located mostly at nose and tail, with the exception of the wing platform.

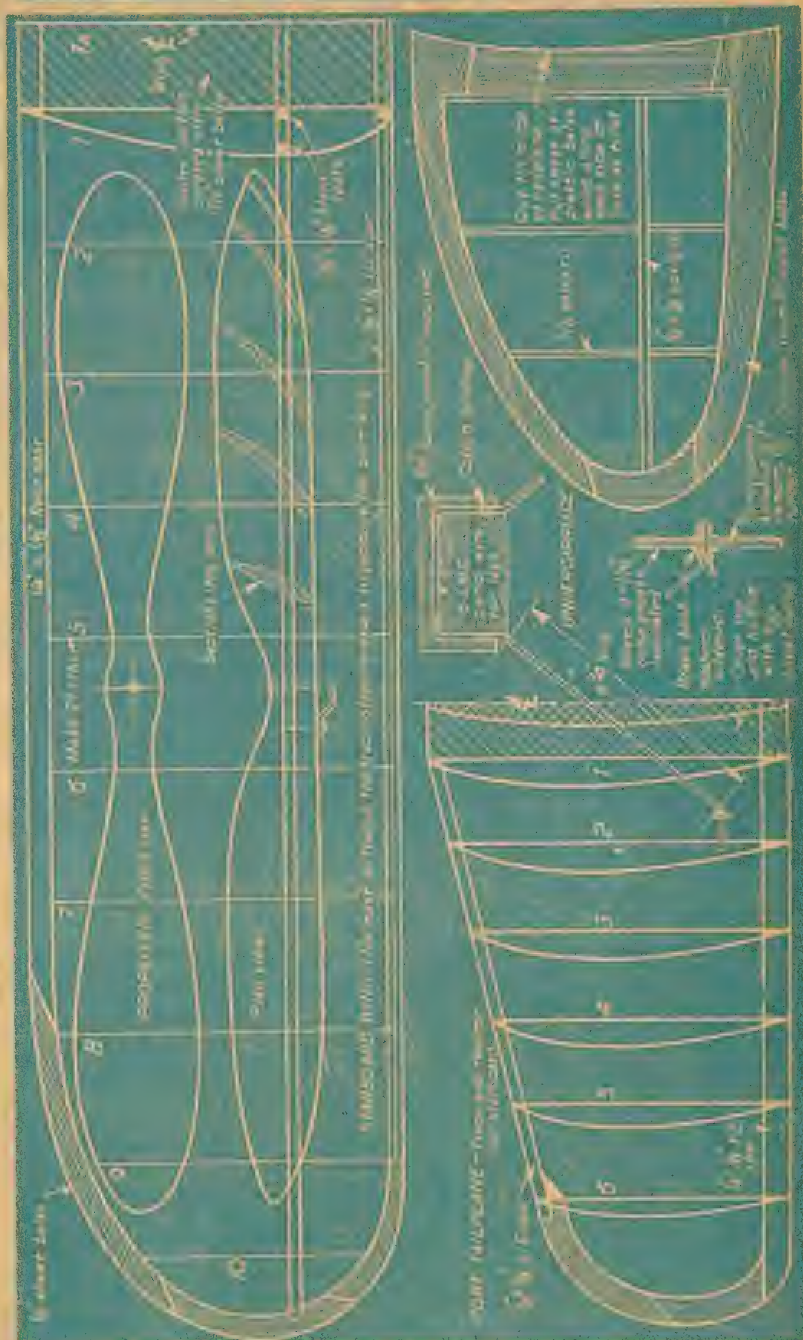
The plastic wood can be obtained at any model shop or ironmonger and can be mixed with a little balsa cement. When it dries it "spreads the load" of highly stressed parts. This is an invaluable feature not seen in many models. It certainly adds very little to the weight, but adds tremendously to the strength, reliability, and long flying life of the model

Wing platform and tail platform are cemented on. The nose piece is made from laminated pieces of balsa wood and then carved to shape of the model's nose. The nose is drilled to take a bearing tube, and this drilling must be dead centre.

Bearings and little ball races to take the propeller thrust can be bought from model shops.

The wire propeller shaft is carefully bent to shape by round-nosed

DETAILS OF FLYING SURFACES



Here are details of the wing, fin and tail surfaces, also the propeller outline.

pliers. The free-wheel mechanism makes for long glides and prevents a stopped propeller causing spiral dives on the glide. It is therefore well worth the trouble of making although for general purpose flying it is possible to fly with a fixed propeller. This, however, is not advisable if the maker can construct a free-wheel gear as shown on the blueprint.

The propeller is a very vital component, for it hands out the power. Propeller carving by a novice is not perhaps as easy as the rest of the model building. A piece of hard balsa should be obtained, if available, and a blank cut out to the outline shown on the plan by tracing on to the blank. The blades must be carved so that the sections as shown are incorporated and at the correct pitch angles.

This matter of pitch and diameter of the propeller is always a very big secret of a light model's flying success. It is necessary to balance the propeller as an unbalanced one will cause vibration and wobble which will upset the model.

To balance, slowly spin the propeller on a shaft of wire. The blades should come to rest each time at different points. If one blade always stops at the bottom, after rotation it is too heavy and must be sandpapered down to match the other blade.

The flying surfaces are built up on the board, or an absolutely flat surface, over the plan with grease-proof paper interposed, after having cut the ribs to shape with a razor blade, and sanded the outline smooth.

The shape of the ribs must be accurately maintained by tracing the outline on to balsa sheet, with a piece of carbon paper interposed between balsa sheet and plan.

It is a good plan to make up one master rib for the wing, as this saves the plan. The rib can be made from three-ply and used to trace around. It can be used if another

DISPOSALS!

DYNAMIC HEAD PHONES WITH MIKE

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The above 24 volt models can be operated as 32 volt without alteration.

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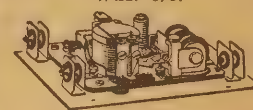

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A practical compass in a bakelite case 2¼in x 2¼in with thumb ring. Calibrated with luminous markings for night use. Invaluable for hikers. PRICE **£1/9/6**

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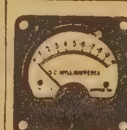

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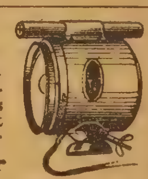

Ideal for holiday camp lighting, etc. Also is a most efficient spot light. Disposals Price **£1/5/-**

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AUSTRALIA'S LARGEST MAIL ORDER HOUSE FOR EX-GOVERNMENT OPTICAL, RADIO & PRECISION INSTRUMENTS.

ving is wanted at any time, and hould be kept.

The correct dihedral is obtained s shown on the blueprint. This is lways important on any well-deigned model, as the dihedral for ateral stability is "balanced" in deign with the side area shown by he fin.

If too big a dihedral is given, this nay cause instability on turns. A mall dihedral has a similar result, nd fails to recover the model in a ust. Blocks under the wing tip ribs vill ensure correct dihedral. (See 'ig. 4a).

Rag tissue paper or Silkspan aper, obtainable from model shops s used for covering.

As mentioned at the beginning of his article, covering is a very imortant feature, for there should be good surface free from drag-makng wrinkles, and the surfaces must

REAR VIEW OF FINISHED MODEL

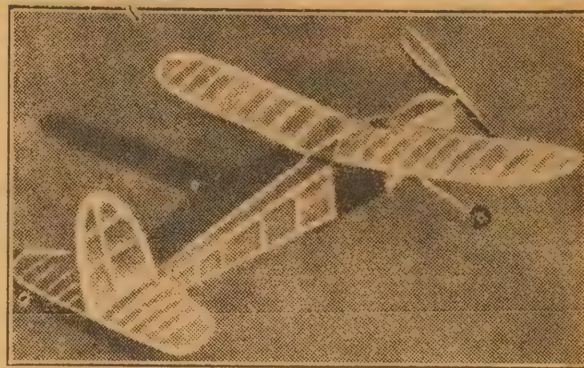
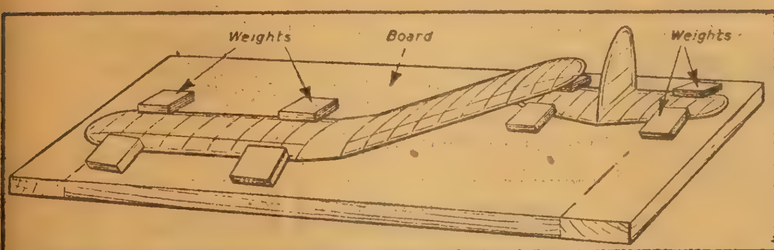


Figure 5. A rear view of the finished model.

☆

Figure 4. (below) Wing surface should be weighted down to prevent warping while the dope dries. Dope each wing separately and do not place on board until dope is dry enough not to stick.



ot be warped by the doped coverng.

So many modellers make a nice air rame and then produce a poor ooking completed model because he covering is bad. Covering is eally not difficult, but it requires a ttle practice and knowledge of the orrect way to do it.

First cut the paper to the rough utline of the fuselage sides with reasonable overlap. Now smear the de to be covered with photopaste. ay on the paper evenly, but do not verwork or stretch. It may look a rifle loose, but provided this is not xcessive, it will not matter for we hall get it taut in a moment. The reat mistake is to overstretch the aper over the framework when dry.

Now trim around the edges, allowng approximately 1/8in overlap. tick this overlap down around the ongerons with photopaste and cover he opposite fuselage side, then the p and the bottom, in that order.

PRAY WITH WATER

Now, borrow a scent spray, and pray water over the covered strucure evenly. When nicely wet allow dry, but not in front of a fire. The aper, if reasonably well put on will ow evenly shrink up, and not a rinkle will be left when dry.

When absolutely dry dope the uselage with two or three coats of ood quality model dope. This may ppear to temporarily slack off the aper between coats, but as each oat is allowed to dry, the paper will ome up taut and gain strength.

Doping must be in a warm room ree from moisture, but not in front a fire. It is important to see that he fuselage is kept down true, so hat it does not twist as the drying kes place on each occasion.

If by any mischance a twist does evelop, or a warp in a wing hapens, it is usually possible to twist hese carefully out by holding in ont of a hot fire, feeling the doped surfaces soften, take away to cool, and releasing the surface when cool. It should remain where one has anti-twisted it as it cools off.

The nose block requires several coats of dope to harden. If the dope blushes, it has either been applied in a damp atmosphere, or is of a cheap and nasty kind. A good dope by a reputable firm is well worth its selection.

Cellon or Titanine are full-size aircraft dope firms of world-wide repute, who also make model dope that gives every satisfaction.

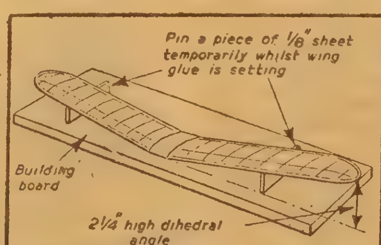


Figure 4a. Setting the wings to the correct dihedral on the building board.

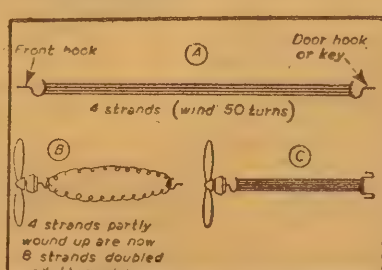


Figure 6. Make up the motor as at "A". Double the 4-strand skein over the propeller hook as at "B", so that the motor becomes 8 strands. Allow the motor to go slack as at "C"

The wing should have two or three coats, and the tail and fin only one, after the usual water shrinking. The tail unit is built lighter and may warp in hot weather if too much dope is used.

Dope should be "flowed" on with a soft brush, and never "worked" in, like paints. Flow it on thickly without actually running. It dries tacky very quickly and any working back and forth by a brush will ruin the result.

METHOD OF COVERING

When covering the wing, start with the bottom and then cover the top, by the same methods as used for the fuselage. Smear the outline with photo-paste, including the bottom runs of the ribs to keep the slight undercamber. This is unnecessary for the tail, which has a flat bottom to its ribs.

While water or dope is drying on the wings, make sure they are weighted gently down to a flat board. This prevents warping as the medium shrinks the covering material. Do not weight until dope dries sufficiently not to stick to the board.

It needs watching. If care is not taken, warped wings and tail will result and flying will be hopeless. One of the secrets of the expert fliers is obtaining unwarped flying surfaces, which enable proper trim to be made.

BALANCE UPSET

Remember: Do not stretch that covering too much. Just lay it on evenly, and the water spray will do the stretching efficiently. Of course, if you put it on unevenly with vast wrinkles, no amount of water shrinking will do the job.

One of the troubles of a rubber-driven model is bunching of the unwound rubber motor, which has to be longer than the fuselage, when the model is on the glide. This may cause a shift of centre of gravity, and the model dives or stalls on the glide.

This is best overcome by making up the motor by the "corded method" as shown in Fig. 6. The cording makes the slack of the motor evenly spaced when unwound.

It is a little more difficult for the novice at first, and means that the motor must be "stretch wound," using a "winder," made up from a geared drill brace, with a hook in the chuck.

If an uncorded motor is used, it

R.C.A. TYPE A.R.B. RECEIVERS

(Made in America.)

CONTINUOUS COVERAGE 195KC TO 9050KC IN 4 SWITCHED BANDS. Valve line up 12SF7 R.F., 12SA7 converter, two 12SF7 I.F. amplifiers, 12SF7 det. and 12A6 output.

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THE MOTOR WITH A THOUSAND USES

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50 CONDENSERS

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PILLO-FONE

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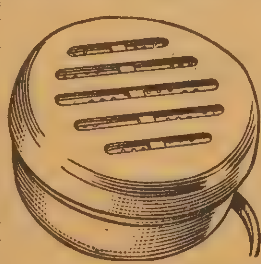

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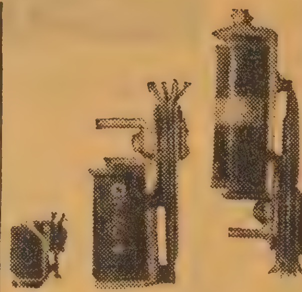

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All relays suitable for rewinding.

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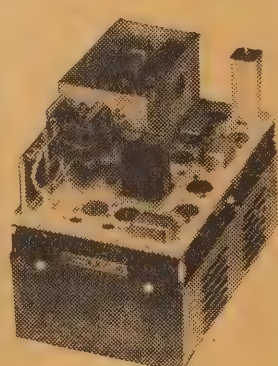

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H.F. Oscillator, frequency approx. 200 m/c complete with two 7193 valves. I.F. transformer. 10 high insulation octal sockets, 45 insulated carbon resistors, mainly 2 watt. 24 paper and mica condensers.

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METROPOLITAN RADIO SUPPLIES - - LM3610

479 PARRAMATTA ROAD, LEICHHARDT (at top of Taverners Hill)

is best to fit one not too long, and to restrict the number of turns put in when wound up, and therefore keep the length of flights short. Even so, this model should get "upstairs" well, and have quite a long glide home when properly trimmed for a good glide.

The beginner may feel this is the best method to gain flying experience, and later indulge in the "corded method" with geared winder. In any case, two things are vital, apart from buying only the very best rubber.

These are: To fit rubber bicycle valve tubing over the hooks to prevent the wire cutting the rubber strip, and to use a really good rubber lubricant. Dry rubber always gives trouble, and will incur extra expense for replacement. Never overwind rubber motors. Fig. 7 gives details for stretch winding.

FLYING TRIM

Now comes the important moment. The secret of success in flying is getting careful gliding trim first, and then controlling the power flight from stalling by alteration to the thrust line.

It is advisable for the newcomer to commence by controlling his model through stable flight trim. The finer shades of trim come with experience.

To this end the glide trim will be dealt with first. It must be quite beyond reproach before we even try a power flight. If it is not obtained and adhered to, the model will stall or dive when the power ends. Glide duration is lost, and the model will probably crash.

First balance the model on the fingers, with rubber in position, and ready to fly. This should be done indoors in still air. The model should balance about the halfway back position from the wing's leading edge to the trailing edge. If not, add a tiny piece of lead to nose or tail. If the model is built properly this will be very small as the design has allowed for the correct balance position.

But people build differently, and balsa wood weight is variable, so there may be slight discrepancies.

FIRST FLIGHT

Now choose a light and steady wind, and if possible take the model out to a soft grass field with longish grass, where the "blow" of possible bad trim glide will be softened until we have got the trim absolutely correct, when the model will glide down to perfect landings.

Launch dead into the wind with fin set straight, and throw the model like a dart at only a medium speed along a level line, and not upward or downward.

If the speed of throw is approximately correct, and the wind light, and the model's balance correct, it will glide flat and long, landing like a feather. The wing surfaces and tail must be square to the fuselage. (See Fig. 8.)

If the nose is heavy the model will dive slightly. Put a little piece of lead in the tail (temporarily retain it there under the tail rubber band) and try gliding again. If correct the nose will now come up and the glide will be good. It might be helped by a 1/16in slip of balsa under the tail trailing edge, if it is still a trifle nose down.

If, on the other hand, the nose has risen on the glide and the model

HOW TO WIND THE RUBBER MOTOR

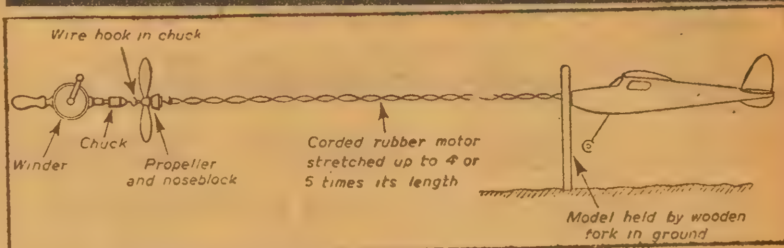

Figure 7. Stretch-winding a corded motor.

balloons up in a stall, or even looks stallish, put a tiny bit of lead in the nose, and if the subsequent glide is better but not quite right, pack a 1/16in sliver of balsa under the front (leading edge) of the tailplane.

Having got this long, flat glide right, build in the pieces of lead (if any have been found necessary) or the bits of balsa packing by cementing into or onto the fuselage with a little plastic wood, to prevent movement in a rough landing.

POWERED FLIGHT

Your model is now a good glider when the power ends, provided you now trim it so that it does not end in a stall during power flight, which is what so many modellers permit. The best climb of a model aircraft, unless it is grossly overpowered, is an even climb, and not at some impossible angle like a helicopter.

At this stage, power flight in easy stages can be tried. First, wind up about 50 turns and have a 1/8in slip of balsa between the top of the nosepiece, and the fuselage former. Try a launch as for a glide, with all glide settings untouched. Never touch these settings for general purpose flying.

If the model flies at low altitude, take away the packing and try again with about 50 turns. If it now slowly gains height try 80 or 100 turns and gradually increase turns in subsequent flights, using down thrust by the packing strip if necessary.

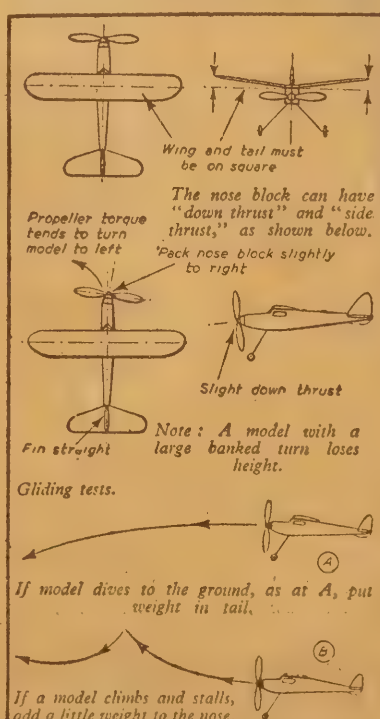

Figure 8. Flying the model.

It will be observed that a certain amount of down thrust has been built into the nose in the design. It may not be necessary to give more. During these test flights we must keep rontrol of the turn by alteration to side thrust by strips of balsa, if necessary.

It must be realised that a sharply-turning model will put its nose down on a banked turn, and a turn will prevent climbing. If excessive it will even nose the model into a spiral dive, which may end its life! In progressing with the tests it is necessary to keep the model turning under power with a slight left turn.

FINAL POINTS

The natural propeller torque reaction will tend to turn it in left circles. Therefore, it is usual to try the first flights with a slip of balsa of up to 1/8in thick wedged between nosepiece and front former on the left side looking at the model from the top to the front. This will counteract the left turn.

Gradually reduce this thickness of packing until the torque reaction carries the model around in slow climbing circles to the left under power with up to ¾ full wind, which is all that should normally be attempted if you want to preserve your rubber motor.

Remember that after a few flights a rubber motor should be rested, when it will regain its natural elasticity. Never keep a rubber motor wound up for long periods.

Keep the fin straight, and all surfaces true, unwarped and placed on "square."

ANSWER TOM

(Continued from Page 35)

In the Radiotron receiving valve manual the schematic diagram for a 1K5-G shows three grids. However, I notice that several Radio and Hobbies circuits show only two grids. Why is this so?

The 1K5-G is a pentode and therefore includes a suppressor grid in addition to the screen and control grids. However, the suppressor is permanentaly connected to the filament inside the valve as you will notice if you examine the Radiotron diagram closely.

In order to make things appear as simple as possible for our readers we have sometimes omitted the suppressor grids where they are permanently connected.

SCIENCE v. RUST

(Continued from Page 13)

alloyed coating of aluminium which withstands a heat of 2100 degrees.

This same process is used to coat cast iron pots in which iron is melted. These are coated with aluminium, nichrome, stainless steel, &c, which imparts heat resisting properties to the pots, preventing scaling and disintegration.

Zinc is now, in many cases, being sprayed onto metal surfaces instead of being applied by the older methods of electro depositing or galvanising. It has been found that a sprayed zinc coating only .003 inches thick gives over four times the protection against salt spray than the galvanised coating of .0025 inches thick. One advantage here of the metal-sprayed process, is that it can be built up to any desired thickness.

The salt spray mentioned above is the process developed in America where synthetic sea water at a temperature of 100 degrees Fah. is sprayed onto experimental jobs inside a cabinet. This salt mist compresses into a few days the effects of months of normal exposure to salt air.

As a further addition to the need for conservation of mineral resources a new scheme has been developed in England for removing rust from metal articles.

THE PROCESS

The active principle of the process is an electro activated alkali solution. The actual alkali used is a secret of the inventors.

In the factory in England there are five 3000 gallon tanks. The first tank contains hot caustic soda solution into which the articles are plunged. This removes grease. An electric current passing through it reduces the time for grease removal from 45 to 18 minutes.

The next tank is a rinse of cold water. The third tank is the de-rusting solution. This tank carries a positive charge from a direct current source. The articles to be rusted are connected to the negative pole.

A positive charge flows from the tank to the negative metal articles. It thus liberates a mass of hydrogen bubbles from the alkaline solution. The rusty surfaces of the articles are bombarded with hydrogen bubbles which also combine chemically with the rust.

Now rust is nothing more than a combination of oxygen with the metal. Oxygen has an affinity for hydrogen and hydrogen and oxygen make water. Thus the hydrogen bubbles combine with the oxidised metal surface and the rust vanishes.

Before the process is complete the current is reversed. This forces the hydrogen bubbles away from the metal and carries away with them the remaining particles of rust.

This process has been responsible for the saving of millions of pounds to British industry.

The articles to be derusted need not be dismantled. Whole machines are treated. Typewriters, car engines, left over war equipment, shells, airplane parts, &c, are being salvaged. Hard-to-get spare parts are being reclaimed. The process does not remove any metal. It merely removes the rust.

AERIALS FOR YOUR NEW XMITTER

(Continued from Page 53)

describe a method involving two extra components in the aerial tuning unit, which allows the transmitter to be used in cases where the aerial and feeders do not add up to a resonant length.

There is a degree of personal choice as to whether it is preferable to cut the feeders to the resonant length or to cut them to the most convenient length, which may not necessarily be resonant. Some amateurs prefer to have the system inherently resonant at the cost of making the feeders somewhat longer than necessary and, say, running them to the transmitter by a round-about route. There is also a good argument in favor of cutting the feeders to the best length from a mechanical point of view and then adjusting the electrical length by means of a more complex aerial tuning unit.

Even with the simple aerial tuning unit under discussion, a small percentage of error in the electrical length of the system is permissible, but where the discrepancy is large it will be found difficult and in some cases impossible to obtain the desired degree of loading.

MOUNTING POSITION

Some readers may prefer to mount the aerial tuning unit at some point away from the transmitter, but such that it is easy to obtain the desired feeder length. This is quite permissible, since the link circuit may be extended over a considerable distance with negligible losses. However, difficulties may arise with the tuning procedure when the aerial tuning unit is so remote that the effects of its adjustment on the meter reading the plate current cannot be noted.

The tuning procedure for each band is fairly straightforward and should not cause any undue difficulty. Start with very loose coupling between the final tank and the aerial tuned circuits. Tune the final to resonance as indicated by a dip in the plate current. Then tune the aerial unit to resonance as indicated by a rise in the plate current. The dials will retain these settings when the aerial is connected if the aerial is exactly resonant. In practice, some re-setting of the aerial tuning condenser must be expected.

Next step is to connect the aerial to the appropriate taps on the coil. If the aerial is being fed at a high current point it may be connected to a pair of taps near the centre tap.

Actually, a worthwhile range of adjustment can be obtained by varying the positions of the aerial taps. If the aerial is connected to a pair of taps near the centre, the "Q" factor of the aerial coil will be high with the result that a small amount of physical coupling (i.e. few turns) will give a great amount of electrical coupling.

As the taps are moved toward the end of the coil, the "Q" factor decreases and the loading on the transmitter also decreases.

Avoid connecting a high impedance load to taps near the centre of the coil, however, because the high voltages developed may cause the tuning condenser to flash over, and power may be wasted because of the high circulating current in the coil.

The final tank tuning and the aerial tuning will become increasingly dependant as the coupling is increased and their optimum settings are best obtained by a two-handed adjustment rather reminiscent of the old-fashioned broadcast padder tuning.

TUNING METHOD

Tune the final tank for minimum plate current, then tune the aerial unit for a plate current rise, indicating that the aerial is now drawing power from the transmitter. Now rotate the aerial knob slowly while rocking the final tank through resonance until the aerial is seen to be drawing maximum power and the plate current dip is least noticeable.

When the final adjustment of the tuning unit is reached, it should thus be possible to tune through a peak of plate current with the aerial circuit and a dip with the final tank circuit.

If it is possible to tune through a dip with the aerial circuit, take this as an indication that the link coupling is too tight.

If the aerial system is of the correct length and the coupling not excessive, the settings of the two controls will be fairly close to the settings recorded for the original tune up.

Having made the initial settings for each band, the tune up procedure when changing bands will involve no more than setting the controls to the previously established points, which can be recorded in a table attached to the transmitter panel and perhaps giving the final tank circuit a final touch.

PARTLY FOLDED

The example of the aerial system we gave is only one of many possible. It is quite legitimate to fold the resonant system so that the tuned feeders attach to one end of the radiating section. The essential is that the radio frequency currents in adjacent feeders be out of phase, so that they will not radiate.

It is never possible to realise complete cancellation of radiation from the feeders when the end feed arrangement is adopted because one feeder is loaded by the radiating portion, while the other is not. Generally the centre feed arrangement is preferable.

We have given several examples of tuned aerial systems.

You will note that the lengths specified for the tuned feeders are slightly greater than the resonant lengths obtained from the graphs. A phenomenon known as "end effect" makes it necessary to apply a correction for simple resonant lengths, but this correction becomes less as the aerial becomes longer in terms of wavelength.

The correction varies with the different bands, but only amounts to a matter of inches in all cases. The dimensions we have given will give the best results over the bands specified. Space does not permit a discussion of end effect here, but there is ample information on the subject available in the standard handbooks.

ANSWERS TO CORRESPONDENTS

W.L. (Culcairn, NSW) sends along a circuit from an overseas magazine with the query of whether it could be adapted for use from 240 AC mains. He also enclosed a query for the "Here's Your Answer, Tom" page.

A: Thanks for your letter W.L. Your material for the "Answer Tom" page will be dealth with in the usual way. The circuit which you enclosed is not recommended for adaption to 240 volt AC power mains operation because of the danger of shock. However, apart from the power supply angle, the circuitry follows normal design practice and details of such sets operating from the usual rectifier/transformer combination are available through the Query Service under the conditions shown in the panel on these pages.

S.E. (Bankstown, NSW) complains of an intermittent "rustling" sound in his receiver. The trouble disappears after about 10 minutes operation.

A: Apparently you have an intermittent component somewhere in the receiver. Unless you are equipped with the necessary test gear, the best plan would be to engage a reliable radio serviceman. If the trouble appears regularly when the set is first switched on, he should not have too much difficulty in locating it. We would tip a faulty resistor in the audio plate circuit of a faulty output transformer.

A.W.L. (Mitchelton, Qld.) writes to compliment us on Radio and Hobbies and also to confirm his own opinion that an output transformer he has on hand will be suitable for use with the "Playmaster" No. 2 amplifier.

A: Many thanks for your letter and the appreciative remarks. Used as you suggest the load impedance for the 6V6-G's will work out at 7800 ohms and the results should be the same as with the original amplifier. Actually, as mentioned in the article, the valve manufacturer's recommendation for the particular voltage conditions is 8000 ohms. Both the transformers you mention are in the high-fidelity class having a frequency range of from 30 to 15,000 cps.

M.C.P. (Waverley, NSW) has been interested in electrical matters over a period of many years and mentions some of his activities. However, the main point of his letter is to take us to task for not having described a hearing aid suitable for home construction.

A: Many thanks for your letter and we were particularly interested to read of your experiment with the carbon microphone. We believe that if the particular type you describe is carefully adjusted it is possible to hear such minute sounds as the footsteps of a fly. Certainly, there is no reason why a miniature amplifier, suitable for deaf aid work, could not be built by home constructors. However, the amplifier is possibly the least of the problems involved in a successful deaf aid. There are so many different types of deafness, each requiring a special treatment, that a special prescription is required in virtually every case if the afflicted person is to obtain the maximum degree of benefit. The problem is now the subject of discussion in the "Let's Buy An Argument" feature.

W.H.B. (Brisbane, Qld.) asks a query on his 1947 Senior Radiogram which after functioning perfectly for a few years, has now developed a peculiar and obscure fault.

A: Well, W.H.B., in view of what you have already replaced, there would appear to be little else which could be the cause of the trouble. However, we suggest that you ensure that the tuning indicator still functions normally as you tune across the station when the fault appears, before drawing the conclusion that the trouble is in the audio end of the set. With regard to the audio end and bearing in mind that you have replaced the valves and capacitors, we suggest that you check the resistors for value and for any sign of overheating, with particular reference to the 200 ohm back-bias resistor. Other steps would be to check all voltages while the fault is present.

W.J.L. (Tamworth, NSW) forwards 12 months subscription and says how much he enjoys the various articles in Radio and Hobbies, particularly "The Serviceman Who Tells." He also expresses his appreciation of the Amplifier Handbook idea.

A: Thanks for your subscription W.J.L., and also for your comment about the magazine and the projected handbook. We are glad that the Serviceman articles are so helpful in your studies and work and hope that you will ultimately realise your hopes for a full time business.

C.R.B. (Henley Beach, SA) is another reader who is keen on the Amplifier Handbook and is very anxious for us to go ahead with the idea. He also lists some of the amplifiers he has built and the success he has had with them.

A: Thanks for your comments on the Handbook project C.R.B., and we are pleased to learn of your success with the Baby Record Player, &c., and trust that the Playmaster No. 1 will come up to expectations. Your comments, along with many others, seem to indicate that the Amplifier Handbook will be well received and we hope to do something in the matter shortly.

J.C. (Sydney, NSW) is another reader who is keen on the idea of an Amplifier Handbook and makes some suggestions for Radio and Hobbies in general. He also submits a circuit of a receiver used by Australian PoW's in Japan and asks if we can explain the operation of the circuit.

A. Your comments about the magazine and the proposed handbook have been noted J.C., and we thank you for the trouble you have taken to list these points. Regarding the circuit you submit, we are of the opinion that it is by no means complete but that it was probably some form of super-regenerative arrangement with the second valve being used as a squelch generator.

L.W.D. (Manly, NSW) wants to know how he can suppress the ticking of a clock and inquires about the properties of various sound-proofing material.

A. It is likely that you will only get really satisfactory results by completely enclosing the clock and this may be more important than the choice of material. We would suggest a box with a glass front and made either from a sound-absorbing material, such as Caneite, or from wood but lined with several thicknesses of felt.

B.M.B. (Rainsworth, Q.) comments on the Super Three in the May issue and advises that he built a somewhat similar circuit some years ago using battery valves and transformer coupling.

A. Many thanks for your letter B.M.B., and we were very interested to hear of your experiences with your own circuit. We do not clearly recall your letter but we feel that you will find this set an excellent AC version of a simple three-valve receiver, and we would also draw your attention to the modified version with pentode output which appeared in last month's issue.

R.T. (Holland Park, Q.) wants to know if it would be possible to rewire the 1950 Pentagrid 5 to the 1951 Jubilee Portable circuit.

A. Since these two sets use the same valve types and are generally similar in circuit style there should be no reason why this cannot be done. However, the smaller size of the portable chassis may be a problem if standard size components were used in the original set, but we gather that your requirements are not necessarily for a portable receiver, but rather, to be able to operate it from AC when available. In this case there should be no objection to build the set on the original chassis. It might be possible to use the transformer and choke you mention but it would necessitate modification of the power supply resistors and some experimental work would be called for. Your change of address has been forwarded to the appropriate department.

W.R.J. (Kanagulk, Vic.) submits some ideas on the use of battery-operated receivers from 32-volt lighting systems and suggests that they may be of interest to other readers and might provide material for the "Reader Built It" page.

A. Many thanks for your suggestion W.R.J., and we have passed your letter on to the staff member who handles this part of the magazine. However, we feel that there are one or two points about the scheme which render it unsuitable for use by unskilled personnel, even though it has given satisfactory performance when used by someone who knows what it is all about.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required, must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 3/6. These are available for nearly all our designs.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

BENCH STYLE METER CASE

(Continued from Page 43)

trimming against the existing pieces. At the same time it is a good idea to run the rule and square over the work at this stage and before these last two pieces are fitted, just to make sure that the final structure will be true.

The final finish can be left to the individual taste and may be either paint, stain or leatherette covering. There is much to be said for the latter method, since it covers any minor defects in material or workmanship.

In our case we had the covering done by a professional cabinet-maker and many readers may prefer to adopt the same procedure. Others may like to try their own hand at this part of the work also.

In any case, the surface should be well sanded and the edges rounded before this is done, the latter precaution being desirable to minimise wear on the covering at these points. The commercial procedure appears to be to cover the top, back, bottom and front with one piece of material, turning over about 3-16in of material onto the sides, and then to cut pieces to exactly fit the sides without overlap except on the 45-degree angle portion.

Some skill will be required to handle the overlap on corners, but it is not really difficult if it is given a little care and forethought. It is better to aim for a butt joint of the two pieces of material rather than allow them to overlap, and this is best done by first allowing them to overlap and then cutting through both layers with a razor blade at an angle of 45 degrees, when it will be found that they will butt neatly.

Finally, fit four rubber feet and a carrying handle, both of which should be available from hardware stores, and mount the meter panel with small wood screws.

TEST LEADS

So far little has been said about the test leads to go with the instrument, and a few words about this seemingly minor item may be in order. These can be purchased ready made, as were the ones for our own instrument, or you may prefer to buy the necessary bits and pieces and make up your own.

In this case the biggest problem is to obtain suitable wire, a really flexible type being required to stand up to constant use, and ordinary hook-up wire is a very poor substitute. As well as being flexible it also needs to be reasonably well protected externally and a covering of cotton braid is desirable.

Ordinary hook-up wire may use only ten strands of relatively heavy gauge wire, while those in the "extra flexible" class may use well over 100 strands of extremely fine wire. This type does not appear to be readily available at the moment, although some of the interconnecting cable assemblies available through disposals contain lengths of similar wire and in many cases they are long enough for use as test leads.

Even with suitable wire there is always the chance of breakage where it is subject to continuous sharp bending, such as the spots where it enters the prods or plugs. To offset this, commercial units fit short lengths of rubber or plastic sleeving at these points to reduct the sharpness of the bend.

WANTED TO BUY, SELL OR EXCHANGE

Cost of Classified advertisements in this section is 2/- per line; approximately five words to a line.

FOR SALE: AR7 and Marconi R1155 receiver, brand new for sale. **G. Laver. Fish Creek, Victoria.**

FOR SALE: University TST AC/V Super Tester. Excellent condition, £35 or offer. **228 Ellena St., Maryborough, Qld.**

FOR SALE: Connoisseur Super Lightweight pick-up, with two detachable heads for Microgroove and Standard recordings. With 5 spare sapphires. As new £14. **H. Anderson, 68 Mathoura Rd., Toorak. Melbourne.**

FOR SALE: Stamp collectors, my sets and singles for beginners or medium collectors are the "goods" in price and quality. Selectioons on request. **N. Cleary, St. Andrews, Victoria.**

FOR SALE: BC348 240V A/C in good order, £35. **V. Holmes, George St., East Maitland. Phone U566.**

FOR SALE: Movie Camera, latest Paillard Bolex H16 **Turret Model, with three fast lens, including Telefoto, imported carrying case and accessories. Brand new, just from Switzerland in original carton. At cost £294, delivered. Miss Marie Hunt, Coffs Harbour. Phone 336.**

SALE: Portable electric gramophone with partly completed built-in 13 watt push-pull amplifier. **J. Treatt, 6 May St., Hornsby, N.S.W.**

SALE: FS6 Transceiver, vibra-pack, phones, power-leads, valves, etc. As supplied to Army. **J. Treatt, 6 May St., Hornsby, N.S.W.**

SELL: T.A. 12 Transmitter and Radio Compass Receiver, good condition. Cheap. **133 Glouster Rd., Hurstville.**

SALE: Quantity parts, incl. mike, trans., .015UF, 6900v. peak discharge, oil cond., spkrs., time delay, and std. relays, C.R.O., Selenium and copper rectifis., meters, valves, chassis, switches, sockets, and sundries. **J. Treatt, 6 May St., Hornsby, N.S.W.**

SALE: Communications Receivers, Marconi CR.100, 60K/cs to 30m/cs, 11- tube £65. CR.100 with spkr. 15 K/cs to 25 m/cs £55; Bendix Freq. Meter BC221, new £45; T1154 Phone-CW Transmitter, 3.5 and 7 m/cs, 120 watt, with tubes, unused, wants pwr-pack 6v and 1000v to complete, £25 in transit case; D104 Mike, new 85/-; Agfa Karat 36 Camera, in case, 35 m/m, F2 coated Heligon lens, coupled range-finder, attached exposure meter, cost £90/10/- few months ago, all as new, £67/10/- or near offer. Any item securely packed free to any part Australia. Air Freight extra. Advertiser, **21 Ryedale Rd., W. Ryde, N.S.W., or phone Sydney JM3212 or WY3225**

SELL: FS6 Transceiver, hardly used. Absolutely complete with microphone, phones, brand new carrying, battery, etc. £35. 240v. American motor, playing desk, crystal, pick-up, £9. Complete. **I. F. Marshall, 82 Kareela Rd., Cremorne, N.S.W. XY4035.**

SELL Microscope Carl Zeiss 3 powers, Micrometer, stage, etc., £10 or offer. Movie Proj. 35mm lamphouse lenses, etc. £12/10/-. Also 5BP1 and socket. 6AC7's four HVR2 for scope £2/10/- lot. **Walton 102 Gloucester Rd., Hurstville.**

SELL: 32-volt 1-3 h.p. Motor, as new. £18. **Bannerman, 50 Fennell St., Parramatta.**

SELL: BRS Motor, T25 3-speed, £30. WRN Transcription P.U. £9. Calstan Oscillator, 95Kc—30Mc, £15. **25 Cobar St., Willoughby.**

WANTED: Accurate Scale Drawings. S.A.R. Rx. 4-6-0 and F. 4-6-2T. locos. **W. A. Lillia, Semaphore Park, Sth. Aust.**

WANTED: Bradmatic Recorder Head, VK2BC. **61 Knowles Av., Bondi. FU5614**

ELECTRONIC FLASH UNITS

(Continued from Page 79)

but, of course, their usefulness is limited.

Comparing the performance of these tubes with the conventional flash bulb, we find that a 100-joule lamp gives a light output of 4000 lumen/seconds compared with 10,000 lumen/seconds for a midget flashbulb, such as the PF14. The effective light from the flash tube is further reduced by what is called the reciprocity failure of emulsions, whereby they do not respond to extremely short flashes of light in the same way as they do to longer ones, and require a light increase greater than a purely proportional one.

On the credit side of the flash tube it must be pointed out that the full light output of the flashbulb is seldom used, the shutter usually being set to a much shorter exposure than the duration of the flash. The fact remains, however, that a greater amount of light is available if required, while larger flashbulbs have an even greater reserve.

In spite of these limitations the portable flash unit has a great appeal to both amateur and professional photographers, and is becoming increasingly popular, since it is still capable of doing 90 pc of the work previously done by flashbulbs. The inconvenience of having to carry a unit weighing several pounds is more than offset by the virtual elimination of running cost, thus making possible a class of work which otherwise would be prohibitively expensive.

LIGHTER SUPPLY

In recent years circuits have improved considerably and a stage of efficiency has now been reached where it is possible to dispense with the heavy accumulator and derive the power from a few small dry cells. When we add to this the improvements made in transformers and capacitors the weight problem becomes far less serious than it was a few years ago and reasonable portable units are now possible without serious sacrifice of light.

Considering all these facts the prospects of designing a satisfactory flash unit for home construction look reasonably bright and we are hopeful that we may be able to present something along these lines in the near future.

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